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TABLETS

OF

ANATOMY.

DISSECTIONAL AND SCIENTIFIC.

BY

THOMAS COOKE, F.R.C.S., Eng.;

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AND

F. G. HAMILTON COOKE.

PART III.—HEAD & NECK, THORAX, BRAIN.

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1876

TO

ELLIS, HEATH, AND HOLDEN,

AND TO THE MEMORY OF

HENRY GRAY,

MEN TO WHOM, IN THIS COUNTRY, AS TO

CRUVEILHIER, HIRSCHFELD, AND CONSTANT SAPPEY

ABROAD,

WE OWE THE SUREST FOUNDATION OF OUR ART,

A PRACTICAL KNOWLEDGE OF HUMAN ANATOMY.

"I regret to find that the teaching of Anatomy is getting more and more into the hands of professors who are not surgeons, and that their tendency is to lay stress on transcendental details rather than on surgical relations."—*Christopher Heath.*

"We may be training a school of more or less scientific anatomists, but we are not insisting on such a curriculum of study, and on such examinations, as will produce in the future well-grounded, thoroughly practical, and efficient medical men. . . . Those scientific anatomists, who concern themselves with other vertebrates, and who, apparently, treat of an ideal evolutionised human body of their own creation, have no experience of the requirements of those who are destined to medical practice."—*The Lancet.*

"The influence on the legitimate teacher is injurious. He has to bend to it, and becomes a lecture-room grinder."—*Professor (now Sir John) Struthers.*

TO

MACALISTER, CUNNINGHAM, BLAND SUTTON,

AND THE EDITORS OF "QUAIN" AND "MORRIS,"

WHOSE MOST INTERESTING VIEWS ARE LARGELY PRESENTED SIDE BY SIDE WITH THOSE OF THE ABOVE NAMED ANATOMISTS.

Already in the forties, it was recognised by Continental authorities that anatomists had little more to discover by the aid of the scalpel; and the

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MAY 25 194

opinion generally accepted that the Progressists had but histological research before them, – a view taken up by Cruveilhier.

The view has been falsified to this extent, that to Histology, which has largely branched off as an independent science, there have been added, as fields of research for anatomists, – anatomists now largely *in name*, – Embryology, and that indefinite and ever-extending body of doctrine which we call Morphology.

On this soil, "Anatomy" is now luxuriating like an exotic.

But "anatomists" have lost touch with the human "subject:" Their work is authoritatively described as "transcendental."

A scission is upon us.

It must lead to this:

On the one hand, we shall have Anatomy – divested of everything not simply and purely dissectional, of everything that was never HERS; but, as such, once more recognised as the ALMA MATER of EVERYTHING MEDICAL: The Newest Anatomy will be the Old Anatomy, – tried, purified, *not* found wanting, – reinstated in her singular position of honour, rightly associated with the names first given.

But side by side with this Anatomy, there will be brought forth a Science, already budding into existence, but which is not yet correctly and definitely named, – *it is* NOT *Anatomy*, – which will satisfy the worthiest aspirations in the direction of progress.

There are to-day two intersecting lines of thought, two largely disagreeing currents, – the new scientific, or *theoretical*, – and the old *practical*. These must be brought into parallelism.

"He (Mr. Cooke) would have teachers and examiners, not specialists, but men of a general knowledge of both anatomy and physiology. This would result in a much sounder valuation of the details of both subjects, and would improve the character of the examination."—*British Medical Journal.*

"Mr. Cooke has done good service in bringing this subject prominently before the profession. It is one that requires very thoughtful consideration with a view to reform."—*The Lancet.*

". . . . plain speaking and hard hitting: but Mr. Cooke is right in what he says. Men go up for examination; they are prepared; they are examined; they are not educated. This is probably due to the cause to which Mr. Cooke attributes it. Too much attention is given to the *science* of the subject—too much because it precludes sufficient attention to the *art*. But the science is only of use as a base for the art. . . . . The education of every medical student is a matter of importance to every individual, medical or otherwise. The public has a right to demand that the best methods shall be used—the profession has a right to demand that its interests and its honourable traditions shall be maintained."—*Medical Magazine.*

" Practical anatomy *was* a discipline of *incalculable value*, for not only was the knowledge acquired *an end in itself*, but the method whereby it was gained was *the most valuable part of the entire medical training*. Anatomy occupied a *unique position* in the curriculum. In all other departments the student had no alternative but to blindly accept the dictum of teacher or text-book. Here he was trained to use his eyes and his hands; here he was educated to translate the impressions made by the objects of his study on his senses into words, this enabling him to check the descriptions in his books, or those taught in the lecture room, by comparing the realities under his hands with the verbal accounts of them given by his teachers: *In the dissecting room every student was an investigator*."

ALEXANDER MACALISTER.

(*The italics are the Author's.*)

"What is the primary want of the physician or surgeon in regard to Anatomy? Is it not to acquire *visual* and *manual* familiarity with the human frame? Is it not to know, in the sense of almost seeing through, and, as far as needs be, of dextrously handling throughout, the individual man, woman, or child he is ausculating or percussing, or whose unconscious form lies under his knife on the operating table? What is it that will give him practical insight into the actual case before him, quickness in understanding its bearings, fertility of resource in dealing with its requirements? Is it not mainly the trained hand that makes straight for the right osseous projection, the educated finger accustomed to the feel of this structure and of that, the sharp eye familiar with the most insignificant guide-point, and which recognises at once a little bit of an exposed tendon, or a certain small nerve, or a thin muscular plane? What serves transcendental anatomy here?"

(*A Plea for Practical Work in Anatomy.*)

"To the practical mind, Morphology is but a dazzling dream –a lovable form of fantasy, which, alas! distorts the vision and warps the judgment—a fairy tale, which blinds us to the facts of everyday life!"

"To such as are past masters in all that can be learnt in the dissecting-room, such pure science may convey the delights of learning and culture, and may do little or no harm. But the tyro should keep clear of all such fascinating seductions."

(*Allegory*, – *Notes*, *p.* 108h.)

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PREFACE TO THE ELEVENTH EDITION.

(SOFT PARTS.)

The whole of the Tablets have now been revised by the Authors in the light of modern views.

They further appear in pictorial garb, through the generosity of numerous friends, among whom, Mr. Pickering Pick, editor of Gray's Anatomy, Professors Christopher Heath, Thane, Schäfer, Symington, Ellis, Alexander Macalister, Cunningham, Birmingham, Windle, Reid, Mr. Luther Holden, Mr. Henry Morris, Mr. Bland Sutton, Mr. William Anderson, Mr. Davies-Colley, Mr. Frederick Treves, Mr. Walsham, Mr. Makins, Mr. Shattock, Mr. Parsons, and, abroad, Professors Gegenbaur, Schwalbe, Heitzmann, Sappey, Testut, and others, who, as well as the respective publishers, have all kindly permitted the use of already existing plates.

In regard to the illustrations, though they be rough, perhaps, there are here brought together for the first time both the inimitable sketches of the arteries and veins which we owe jointly to Henry Gray and to Dr. Vandyke Carter, and those brilliant pictures of the nervous system by which Hirschfeld & Leveillé "placed their country," says Mr. William Anderson, "beyond rivalry in anatomical illustration."

The tabulated character of the work threw considerable difficulties in the way of its being illustrated. The figures could not be placed in the midst of the text. They have had to be grouped on separate pages, of such sizes, and in such positions, as could be made to fit in with available space.

As far as possible, the illustrations have been placed either opposite the corresponding text, or in such positions that, *by raising the intervening pages*, text and illustration can be seen at the same time.

The description of the figures is of the briefest. Where fuller descriptions seemed needed they have been given at the end of the section.

The illustrations may be thought by some to be over-numerous. None have been introduced, except on the score of showing certain things left out in others.

At the end of each section a "Summary of Practical Points" has been introduced, taken from the senior Author's "Aphorisms in Applied Anatomy & Operative Surgery." Corresponding questions are set at the end of each of the two last volumes.

Some of the Tablets of the earlier complete editions have been re-introduced, such as those on the deep muscles of the back, – these illustrated from Bourgery and Jacob, – the female genital organs, &c. Thus the Tablets again cover practically the whole ground of dissectional anatomy.

The brain has been recast, as explained in the preliminary remarks appended to that subject.

Being more than doubled in size, the entire work is now divided into three Parts published separately: – I., The Bones; II., The Limbs, Abdomen, & Pelvis; III., The Thorax, and the Head & Neck.

Facilities have again been provided for the easy division of each volume into segments of a convenient size for carrying in the coat pocket. To this effect, the several groups of subjects, – "Anterior Triangle of the Neck," "Axilla; front of arm," "Orbit," &c., – have each been arranged in what bookbinders call a "section;" and if the volume be opened somewhat forcibly between the *front or title page* of one section, and the *last page* of the preceding section, it will easily be divided at this point by simply cutting the bookbinder's threads or tapes. And each section will be found to constitute a pamphlet, which, folded in two, will bear carrying about without falling to pieces. **The advantages of a small book are thus added to some extent to those of a book of larger size** This arrangement has involved, however, some repetitions and a few omissions, the latter generally unimportant, it is believed, and mostly remedied in the Appendix.

The Authors have written throughout for the medical student intending to become a practitioner.

A distinct principle runs through this Edition of the Tablets, – the dissociation, and separate presentation, on the one hand, of the practical, or "dissectional" anatomy, and, on the other, of the "advanced," or "scientific," – or, as it is now authoritatively called (Christopher Heath) "transcendental" – anatomy recently introduced, – *i.e.*, on the one hand, of the anatomy "that can be seen and handled," and, on the other, of "that which cannot."

The former is presented in the Tablets proper.

The latter, or the newer matter, is presented in the Notes on lighter-coloured paper, – these to be re-written from year to year, as may be required. Here important additions have been made to the abdominal viscera, the cranial nerves, the muscles of the larynx, &c.

The division is found, in the Author's classes, to markedly facilitate both the practical work and the abstract study.

The presentation of the new matter, apart from that which is not new, will have an advantage. It will make it the more evident what the real nature of the new matter is. It will be felt that a large part of this differs fundamentally from plain human anatomy; so much so that the two things will have, it is believed, to part company sooner or later, as has been the case, of late years, with histology and anatomy proper.

Different, not only in degree, but in nature or kind, is the attitude towards the "subject" of the student of to-day, as compared with that of the men of but a few years ago. But recently, the object was to dissect, and see, *everything*. Now we go by the "subject" just so far as the "subject" is, so to speak, the most convenient illustration of itself. The limbs are of easy dissection. So we look at biceps, brachial and femoral arteries; and at the carotids, and so forth. But go further afield. Take the herniæ, take the perinæum, take the deeper parts of the head & neck; take especially the visceral cavities and their contents. Here the dissection becomes more difficult: for it to be satisfactory, work both careful and intelligent is required. Here the "parts" are no longer the most convenient illustration of themselves. So we take to plate and model.* And stomach, liver, pancreas, spleen, kidney, are they not "all wrong" in the dissected "subject?" † Here we learn everything (save the mark!) from the reconstructed cast.

Fatal, in effect, to sound practical work is the influence of the "infinitely little" (Sir Dyce Duckworth), now so largely introduced into our text-books. Embryology and Morphology are clearly "out of it" in regard to dissectional anatomy. Not so, unfortunately, the "infinitely little." The "trivial and exasperating details" (Patteson)‡ are always based on the implied assertion, Dissect, and you will see that it is so. The assertion is dissectionally incorrect in most cases, – incorrect in "knife and forceps anatomy" (Mitchell Banks). The Author will stake on this his authority as a *human dissectional anatomist* of over thirty years' standing.

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* "*Numbers who dissect dwindling to a minimum;*" "*Dissections of the deeper parts seldom done now*" (Leading articles in the *Lancet* for Jan. 20th, 1894, and Feb. 6th, 1897).

"The new school dissects but little. It explains, and tries to get men to 'understand'—that is, to imagine. It is true that things are not so *in principle*. *In principle* the new school insists strongly on practical work of all kind. 'One part dissected with care,' writes Professor Macalister, 'is worth a dozen hurried over.' Indeed, the zeal and personal example of the leaders are admirable. But the field of work is so enormously extended by the superadded 'transcendentalism,' that theory and practice cannot go hand in hand. The highest aspirations notwithstanding, the fact is as above stated. – Letter to *Lancet* for May 27th, 1897.

† See the New or "Reconstructed" Abdomen, pp. 132a-bb. The descriptions in Gray, Ellis, Heath, and Holden – so far as they have not been altered of late years – express the experience of thousands of assiduous dissectors during the most earnest dissecting period we have traversed, the period that produced a Hirschfeld and a Sappey. Are these to be set aside for small innovations coming from a source essentially different from that of simple unbiassed observation?

‡ "There must be something radically wrong in the teaching of anatomy which makes the large majority of students loathe and shirk the tedium of dissecting. Anatomy is not taught as the handmaid of Surgery, but as a separate science bristling with technicalities and overloaded with trivial and exasperating details. Hence it is unwillingly learnt, and readily forgotten. And the vast majority of facts, which are all-important in surgery, are soon engulfed in the wreckage which follows the emancipation of an overburdened memory."—(R. C. Patteson, Surgeon to Meath Hospital.)

It will be seen that the Author contends for the supremacy of simple careful dissection in the dissecting room as the criterion and gauge of excellence in regard to the kind of anatomy to be applied by the medical man to medical and surgical purposes. Dissectional anatomy, he maintains, is to be looked upon as a science in itself, independent of, and superior to, the fascinating nicetics of the scientist. It is the only form of anatomy which serves directly the objects of the medical man. It is also the only form of anatomy which has a history at its back, – and a history of noble self-sacrifice and of worthy service rendered. *Alone, to the Author's mind, it constitutes* ANATOMY *in the professional sense.*

Everyone really familiar with the dissected parts may, it is contended, rely upon success at examinations, – and in after-life, as far as the foundations of medicine and surgery are concerned. It is the Nemesis of book-work and "cram," the necessary outcome of Specialism, that is condemning to failure the undoubtedly earnest – though misguided – efforts of students and teachers alike.*

But we are losing our guiding principles now.

The educational problems fast coming to the front† required to be argued

---

* "Mr. Pridgin Teale's table of the rise of rejections, taken every fifth year, is as follows :—

1861	...	...	...	...	...	...	...	12·4 per cent.
1866	...	...	...	...	...	...	...	14·5 ,,
1871	...	...	...	...	...	...	...	16·6 ,,
1876	...	...	...	...	...	...	...	22·2 ,,
1881	...	...	...	...	...	...	...	30·0 ,,
1886	...	...	...	...	...	...	...	34·8 ,,
1891	...	..	...	...	...	...	...	39·3 ,,
1895	...	...	...	..	...	...	...	41·9 ,,

"'*The Need for Reform of the Medical Examination System.*'—(Pridgin Teale, F.R.S., Crown Member of the General Medical Council)."

The official returns presented to the Royal College of Surgeons of England for the years 1896 and 1897 show the average of rejections at the second examination to be, for 1896, 42·7, and, for 1897, over 50 per cent. *at each one* of the four quarterly examinations. For those going up in anatomy only, the percentage of rejections was 56·3 in 1896. At the Fellowship Examination held in May, 1897, the rejections exceeded 70 per cent.

"At least one-third of those who begin their medical studies," says the leading article (Address to Students) in the Students' number of the *Medical Times and Hospital Gazette* for the present year, "retire from the field before they have fulfilled their course." It is within the Author's distinct observation that the proportion of the complete and irrevocable failures at the stage of Anatomy and Physiology is now vastly on the increase.

"We are brought face to face with a real and growing difficulty, and must come to a deadlock, unless some satisfactory measure of reform in our method of education be devised."—(Macalister.)

† *Re* "Dissectional Anatomy & Paper Anatomy," in Deep Origins of the Cranial Nerves.

"Men leave more and more everything that ties them in any way. Why should they be troubled with supervision that cannot help them? *They can best get up the book-work*

with facts in hand, – *over the "parts"* as regards anatomy, and as occasion might present, here a little and there a little.

Hence the interposition of contentional matter throughout the Tablets, which may occasionally be vexatious, it is feared, to those merely wishing to "read up" their anatomy in the shortest time.

Leave is asked to present the Tablets, not only in the light of an anatomical treatise, but also in that of an **Educational Thesis** based on the facts brought out in the study of anatomy.

Viewed from this standpoint, the various contentions, disputations, criticisms, or whatever they may be termed, which are interspersed throughout the work, will appear less out of place than they otherwise might be thought.

There are *two books here*, – a **Treatise**, and a **Thesis.**

Should "the tares" (?) have been gathered?
With them might have been plucked some good ears of corn.
They are left – with apologies – **in the Thesis.*** .

The book has been lightened, however, in the connection here discussed: "Specialism in Medical Teaching and Examining," "Conditions leading to Success at

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in their own way. And they thus get up the book-work, supporting it on the slenderest substructure of practical knowledge which will just prop it up for a time, – the 'crammer' cleverly binding together the 'scaffolding of words,' – till the examination is past, – when the whole thing is cleared away, like the bunting of holiday rejoicings. Rejoicings, now that the student has past, that he will have nothing more to do with anatomy and physiology!"

"Pity on the poor patients!"

"But, if the student has not past, the 'house of cards,' &c.

"We may be training a school of more or less scientific anatomists, but we are not insisting," writes the *Lancet*, "on such a curriculum of study, and on such examinations, as will produce in the future well-grounded, thoroughly practical, and efficient medical men. Human anatomy must be studied from the human standpoint. . . . Those scientific anatomists who concern themselves with other vertebrates, and who, apparently, treat of an ideal evolutionised human body of their own creation, have no experience of the requirements of those who are destined to medical practice."– (*Lancet*, from January 20, 1894.)

* The Thesis is necessarily interlinked with the new matter, and thus fragmentarily scattered amidst the Notes on the lighter coloured paper.

Examinations and in After-Life," "Advice to Students," – originally written as part of the Preface – have been taken from the book itself, and placed, loose, at the end of Part II., under the cover.

Let it not be gathered that the Author is in any way opposed to "advanced" anatomy. But he does maintain that such Anatomy* should be brought in in the right place, – that is, *after* plain human dissectional anatomy has been well mastered, and then without any misunderstanding as to its subordinate rank in regard to professional purposes.

A word of explanation is required as to the figures.

The proper use of plates and diagrams is for the purpose of identification of the several structures by the beginner, and for saving time in regard to book-work at home, and thus allowing *more time* for *practical work*. It is hoped that the figures of this Edition will be so used. Except for the purposes of revision of work already well done, figures should not be the objects of separate study.

The senior Author is alone responsible for all contentional matter; in regard to such matter, he has frequently been designated simply "the Author."

The considerable delays are apologised for, which have occurred in the publication of this Edition. They have been mainly due to the serious character of large portions of the "Thesis" which runs through it, – as above explained. The Author has desired to carefully weigh, – and to submit to competent critics, – the grave conclusions he has been compelled to adopt in many weighty matters.

That he has been intensely earnest will, he thinks, be apparent.

He maintains that, through circumstances amenable to improvement, men are far less equipped now-a-days for the work that is before them than they formerly were.

An honest effort has been made to establish this on the basis of Anatomy, and to suggest the remedy.

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* Does the term *Anatomy* properly apply?

EXTRACTS FROM PREFACE TO THE TENTH EDITION.

There is such a thing as damaging a book in re-editing it.

It is refreshing, in this connection, to read, in the preface to the last Edition of Gray's "Anatomy," that the work "is intended for students of surgery rather than for the scientific anatomist," and that "it is practical rather than abstract and theoretical." In thus taking the lead in the long-looked-for return to what, in the Author's opinion, Anatomy should be, the Editor of Gray is again doing good public service. Is it looking for too much, – it may perhaps be asked, – to hope that certain small additions made here and there to this noble book, under the influence, undoubtedly, of recently prevailing views, may, to use the words of a great teacher, be put back ere long in "their proper place of unimportance," – that is, removed from future issues? As was well said in a recent article in the *Lancet*, anatomical descriptions properly represent averages. Is it not then misleading, – indeed, calculated to defeat the practical purpose aimed at, – to include among the branches of arteries and veins certain insignificant offshoots occasionally found, or said to be found, by some exhaustive writer or other?

It is submitted that *embryological studies tend to such additions*. The examination of the various vanishing parts of the embryo, and the occasional persistence of *certain* of these, – (as in the case of the *vas aberrans humeri* explaining the high division of the brachial artery, and its exceptional relation to the median nerve, and of the *vas aberrans aortæ* explaining the origin of the right subclavian artery as a fourth branch of the aortic arch) – lend a misleading interest to other, quite exceptional, cases of a similar type, – an interest, indeed, proportionate to their very rarity, – that is to say, fictitious. It is not practical forethought, – much as this is pleaded, – which is here brought into play, but the mere "collectioneering" instinct. It is earnestly submitted that the extended study of "varieties" is a source of *weakness, not of strength*, to the practising surgeon. The same may be said of the morphological work now pressed far too much to the front for *practical* purposes.

Microscopical Embryology.—The portion of the science of development which mainly throws light upon, and may therefore be considered, in a way, the basis of, advanced Anatomy, is that which refers to the larger processes of evolution connected with the throwing into shape of the various permanent structures. Neither do

the membranes come in in this connection, which form, so to speak, the common environment of fœtal life, nor does the minute anatomy of any part of the embryo. Such processes as may be followed either with the naked eye, or with relatively low powers, and may therefore be grouped together under the above heading, are alone introduced into this Edition of the Tablets.

The macroscopical outlines submitted may not be without some advantages, which fuller descriptions would not present. They may better disengage the leading points, and thus allow the reader to follow more easily what one may perhaps call the thread of the subject. When once main lines are well grasped, details are easily filled in.

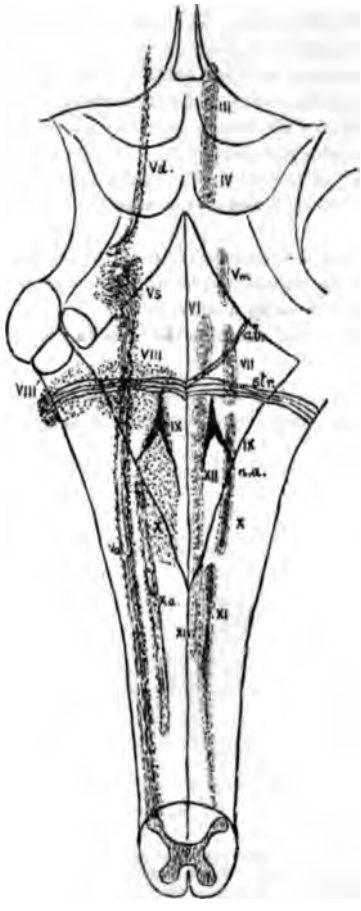

FIG. 358A.—NUCLEI OF THE CRANIAL NERVES, AS SEEN FROM BEHIND. (Quain.)

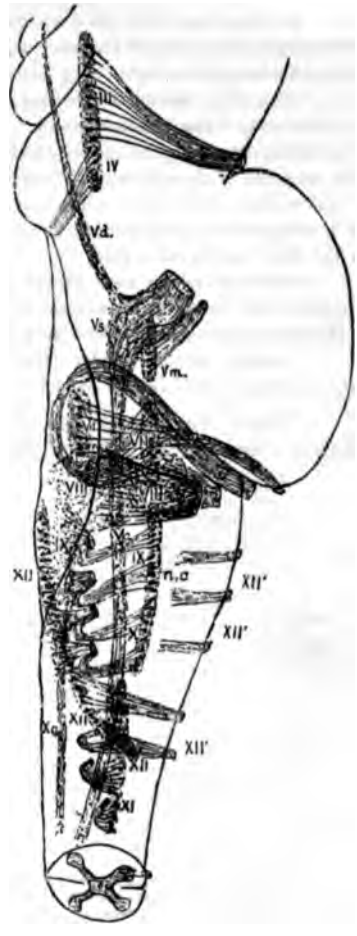

FIG. 358B.—SAGITTAL SECTION, SHOWING NUCLEI AND ROOT-FIBRES OF THE CRANIAL NERVES. (Quain.)

The parts are supposed to be transparent in both figures. In Fig. 358A the motor nuclei are shown on the right side, the sensory nuclei on the left. In these figures the several nuclei and root-fibres are indicated by the corresponding Roman numerals of Sömmering's classification.

DEEP ORIGINS OF THE CRANIAL NERVES.

The study of the deep origins of the cranial nerves has of late attained such prominence, that, – fictitious though such prominence be from the point of view of the

dissectional anatomist, – it has, nevertheless, been thought desirable to preface the pages on the Head and Neck by an examination of the present position of the subject.

The subject is really an easy one, if properly taken.

In connection with the deep origin of *each one* of the cranial nerves in succession, will the reader first look for the nucleus, or nuclei, in Fig. 358A. The reader should keep this figure *constantly* in view ; Fig. 358B should be set aside till later on.

Fig. 358A shows the several nuclei as looked at from behind, the medulla and pons being taken as transparent. The *motor* nuclei are mapped out on the *right* side of the figure, the *sensory* on the *left*, and all are marked with Roman numerals corresponding to the order of succession of the nerves in Sömmering's classification. Where a nerve has both sensory and motor nuclei, as in the case of the fifth (V.), glosso-pharyngeal (IX.), and pneumogastric nerves (X.), one nucleus will be found on one side of the figure, and the other on the other side.

Will the reader next examine the sectional figures referred to in the following paragraphs, and trace out the several statements on the coronal and sagittal sections given. All the statements submitted will then, it is believed, be *easily* understood.

Finally, will the reader return to Fig. 358B, and examine the same in the light of the concluding remarks on page 152*s*.

Third Nerve (*See Figs.* 358A, C, & D).—Arises mainly from the elongated oculomotor nucleus (N. III.) on the upper part of the floor of the aqueduct of

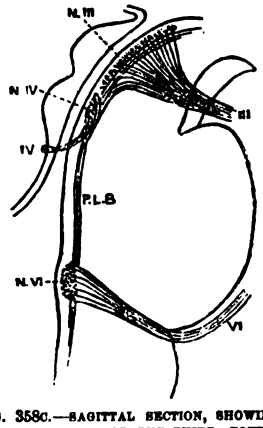

FIG. 358C.—SAGITTAL SECTION, SHOWING NUCLEI AND ROOT-FIBRES OF THE THIRD, FOURTH, AND SIXTH NERVES. (Quain, after Gowers.)

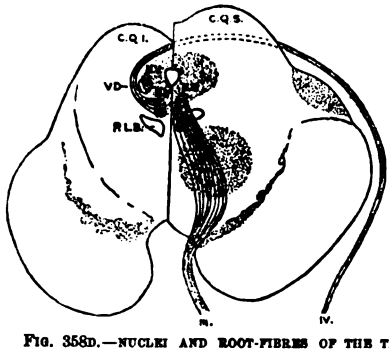

FIG. 358D.—NUCLEI AND ROOT-FIBRES OF THE THIRD AND FOURTH NERVES SEEN ON TRANSVERSE SECTIONS. (Thane, in Quain's Anatomy.)

The transverse sections of Fig. 358D are made respectively through the superior quadrigeminal . C.Q.S. (right side of figure), showing details of third nerve, and through inferior quadrigeminal body, C.Q.I. (left side of figure), showing details of fourth nerve. P.L.B., posterior longitudinal bundle ; V.D., descending root of fifth nerve ; N.V., the corresponding sensory nucleus.

In these, and the ten following figures, the root-fibres are indicated by the Roman numerals of Sömmering's classification ; and the corresponding nuclei are indicated by the same numerals, preceded by the letter N.

Sylvius opposite the superior quadrigeminal body ; some of its root-fibres appear to be derived, however, from the nucleus of *sixth nerve* of the *opposite side* (N. VI.) *through the posterior longitudinal bundle* (P.L.B.). The mass of the root-fibres pass ventrally through the tegmentum, traversing the red or tegmental nucleus (Fig 358D), and emerge

in ten or twelve bundles from the oculomotor groove on the inner border of the crus cerebri. Some of the root-fibres are believed, however, to reach the nerve-roots of the facial nerve through the posterior longitudinal bundle (See deep origins of facial nerve), and to supply the extra-orbital muscles moving the eye-lids.

Fourth Nerve (*See Figs.* 358A, C, & D).—Arises from a much smaller nucleus (N. IV.) on the lower part of the floor of the aqueduct of Sylvius opposite the inferior quadrigeminal body, which nucleus is continuous superiorly with the nucleus of the third nerve. The root-fibres first run caudalwards for a short distance, and then curve backwards and inwards round the aqueduct, decussate in the valve of Vieussens (Fig 358D), and emerge from its upper part.

Sixth Nerve (*See Figs.* 358A, C, E, F, & N.)—Its nucleus is a collection of nerve-cells lying in the grey matter of the floor of the fourth ventricle above the lineæ transversæ, and just external to the postero-median fissure and to the ascending portion of the root-fibres of the facial (eminentia teres). The root-fibres of the nerve start from the inner part of the nucleus, embraced on their inner side by the loop of the facial root-

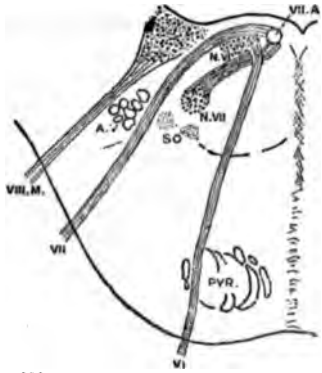

FIG. 358E.—TRANSVERSE SECTION THROUGH PONS, SHOWING NUCLEI AND ROOT-FIBRES OF SIXTH AND SEVENTH NERVES. (Quain, after Schwalbe.)

In VII. A., the ascending portion of the root-fibres of the seventh nerve is shown on transverse section, as made plain in Fig. 358F.

S.O., superior olive; A.V., ascending or bulbar root of fifth nerve; VIII. M., medial root of auditory nerve.

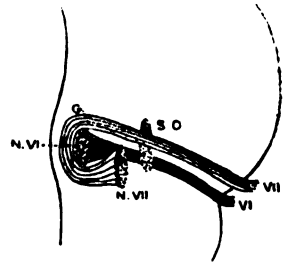

FIG. 358F.—SAGITTAL SECTION THROUGH PONS, SHOWING NUCLEI AND ROOT-FIBRES OF SIXTH AND SEVENTH NERVES. (Quain.)

The ascending portion of the root-fibres of the seventh nerve is well shown (crossed by the dotted line leading to the nucleus of the sixth nerve), as it ascends between this nucleus and the postero-median fissure.

fibres; they then descend to the lower and central part of the pons, on the inner side of the superior olive (S.O.), below and internally to the root-fibres of the facial, to reach the upper part of the anterior pyramid. Some of the root-fibres are believed, however, to reach the third nerve of the opposite side through the posterior longitudinal bundle.

Facial Nerve (*See Figs.* 358A, E, F, & N).—Its nucleus lies externally to, and a little lower than, that of the sixth nerve, but a good deal farther from the surface, in the midst of the reticular formation. The root-fibres take a peculiar and most tortuous course [for full information as to which the reader is referred to investigations of Duval (Testut's Anatomy)]. Briefly described, this course is as follows:—The bundle first passes dorso-medially to the inner side of the lower end of the abducens nucleus (N. VI.);

it then ascends cephalwards for a short distance between this nucleus and the postero-median fissure, beneath the inner part of the eminentia teres; it then bends outwards in front of the upper end of the abducens nucleus, which it thus embraces; finally it runs forwards and outwards through the lower part of the pons to the point of emergence of the nerve between the olivary & restiform bodies. The above description applies to the main root-bundle, but it is now believed that the fibres to the extra-orbital muscles controlling the eye-lids (orbicularis, corrugator, supercilii, & frontal portion of the occipito-frontalis) are derived from the nucleus of the third nerve, and that they reach the issuing fibres of the facial through the posterior longitudinal bundle.*

The portio intermedia of Wrisberg would seem to have quite a different origin, and a different distribution. It would appear to have its origin in the upper part of the glosso-pharyngeal nucleus (Duval); and to run mainly in the course of the chorda tympani, – thus reaching the mucous membrane of the front part of the tongue and supplying sensory fibres to it.

Auditory Nerve (*See Figs.* 358A, G, *&* M).—The root-fibres of the auditory nerve are derived mainly from the principal, or dorsal, and from the accessory, or ventral, auditory nuclei; a few of the fibres appear, however, to have other and distant origins below referred to. The fibres of the *anterior or mesial portion* of the nerve (VIII. M.), which

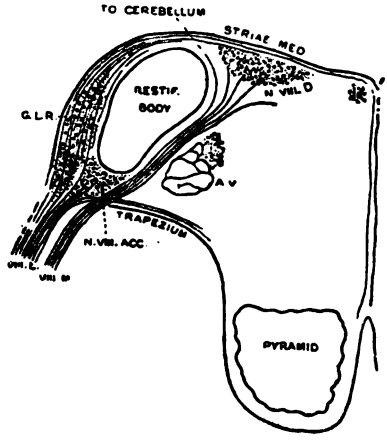

FIG. 358B.—TRANSVERSE SECTION, SHOWING NUCLEI AND ROOT-FIBRES OF AUDITORY NERVE.
(Thane, in Quain's Anatomy.)

The section is made at junction of bulb with pons. VIII. M., VIII. L., the two bundles of root-fibres, mesial and lateral; N. VIII. D., principal or dorsal nucleus; G.L.R., ganglion of lateral root; A.V., ascending or bulbar root of fifth nerve.

runs in front of the restiform body, arise mainly from the principal, or dorsal, auditory nucleus (N. VIII. D.), which forms the tuberculum acusticum near the middle of the floor of the fourth ventricle; some of its fibres are said, however, to descend from the cerebellum, and others to cross the raphé and to be derived from the opposite side of the pons. The fibres of the *posterior or lateral portion* (VIII. L.) are derived mainly from the

* The posterior longitudinal bundle conveys root-fibres from the third nerve to the facial nerve, and root-fibres from the sixth nerve to the third nerve of the opposite side.

accessory, or ventral, nucleus (N. VIII. Acc., Fig. 190; VIII'., Fig. 184), situated between the two portions of the nerve in front of the restiform body. But there is a large collection of ganglion cells (G.L.R.) in this lateral portion of the nerve as it lies on outer side of the restiform body; several of the root-fibres arise, no doubt, from these; and some appear to be continuous with the lineæ transversæ, or striæ medullares, on the floor of the fourth ventricle.

Spinal Accessory Nerve (*See Figs.* 358A, B, & K).—The origins of this nerve are quite simple. Both its spinal and its bulbar, or accessory, portions arise from a long and continuous column of cells (XI.) which extends from the level of the fifth or sixth cervical nerve to the level of the lower third of the olivary body, and is contiguous superiorly with the principal nucleus of the pneumogastric and glosso-pharyngeal nerves (IX. & X.). Inferiorly, this column belongs to the anterior horn of the grey matter; higher up it becomes lateral, and then dorso-lateral, to the hypoglossal nucleus (XII., Fig. 358A; N. XI., Fig. 358K). The root-fibres first run dorsally for a short distance, and then turn outwards towards the sides of the cord and medulla, to emerge from the lateral column of the former, and, from the latter, between the olivary and restiform bodies below the pneumogastric nerve.

Glasso-pharyngeal and Pneumograstic Nerves (*See Figs.* 358A, B, H, & L).—The deep origins of these two nerves should be described together. They have both one principal and two accessory nuclei. The principal nucleus of both nerves (sensory nucleus) is a broad and somewhat elongated column of cells (IX. and X.), which lies superiorly in the ala alba externa and lower part of the tuberculum acusticum, and inferiorly in the ala cinerea on the outer side of the hypoglossal nucleus (XII.).* As accessory, or motor, nuclei (Duval, Testut) of these nerves there are to be considered the so-called nucleus ambiguus, and the funiculus solitarius. The *nucleus ambiguus*† (N. AM., Fig. 358H, and *n a.*, Fig. 358A) lies in the formatio reticularis, somewhat external and ventral

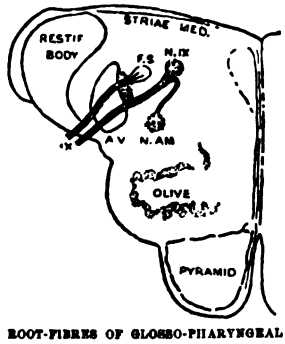

FIG. 358H.—PLAN OF NUCLEI AND ROOT-FIBRES OF GLOSSO-PHARYNGEAL AND PNEUMOGASTRIC NERVES, AS SEEN ON TRANSVERSE SECTION. (Quain, after Obersteiner.)

The section is made through the upper part of the medulla, and shows the nuclei and root-fibres of the *glosso-pharyngeal* nerve. A section made a little lower down would be very similar in character, and would show the nuclei (in continuation of the foregoing) and the root-fibres of the pneumogastric nerve. N. IX. may therefore be taken as the principal or sensory, and, similarly, N. AM. (nucleus ambiguus) and F.S. (fasciculus solitarius) as the motor nuclei of both nerves.

* See Floor of 4th Ventricle, p. 321, where there will also be found a short account of the nuclei of origin of the several cranial nerves.

† The term "nucleus ambiguus" is merely expressive of the fact that views have differed as to whether it is sensory or motor in character.

to the principal nucleus, with which it is connected by a stalk of grey matter. Motor root-fibres to both nerves ascend along this stalk to the floor of the fourth ventricle, and then turn outwards to their two respective destinations. The *funiculus solitarius* (F.S., Fig. 358H ; X*a*, Fig. 358A) is a longitudinal bundle of white fibres surrounded by gelatinous grey matter with a good many nerve-cells. Inferiorly, this fascicle seems to lose itself in the cord ; superiorly, it is seen to give off distinct bundles of nerve-roots [motor (Testut, Duval)] to the glosso-pharyngeal and pneumogastric nerves.*

From the above deep origins the root-fibres of both nerves are seen to pass forwards and outwards through the medulla, separating the middle and posterior areæ shown in Fig. 195.

Hypoglossal Nerve (*See Figs.* 358A, B, K, & L).—Its nucleus is a long column of nerve-cells lying in the lower or closed part of the medulla, below and external to the central canal, and, in the upper or open part, on the lower and innermost part of the floor of the fourth ventricle internally to the inferior fovea. The root-fibres pass downwards and outwards to the groove between the anterior pyramid and the olivary body, separating the anterior and middle areæ of the central part of the medulla (Fig. 358L).

Fifth Nerve (*See Figs.* 358A, B, I, J, K, L, M, & N).—A preliminary remark seems called for in regard to the deep origins of the fifth nerve. No less than eight figures, – sections reviewing the greater part of the medulla, pons, and mesocephalon, – are required to exhibit, at the various levels, the prolonged course of its descending and ascending sensory roots. Here the abundance of the necessary illustrations may, without a word of warning, embarrass rather than otherwise. In the study of the deep origins of the fifth nerve, the student should again fix his attention, first on Fig. 358A, and then on Fig. 358I. These are the two key figures.

The fifth nerve has four nuclei, one motor nucleus (see *right* half of Fig. 358A) corresponding to the smaller or motor portion of the nerve, and three sensory (see *left* half of same figure) corresponding to the larger or sensory portion.

The motor nucleus (V.M.) lies beneath the grey matter of the upper part of the floor of the fourth ventricle, a short distance from the middle line, but internally to, and deeper than, the middle sensory nucleus, below referred to. The fibres of the motor root are joined superiorly by those of the descending sensory root (V.D.).

The sensory nuclei may be termed upper, middle, and lower. The upper sensory nucleus is a collection of nerve-cells lying on the floor of the aqueduct of Sylvius externally to the nuclei of the third and fourth nerves (farther from the middle line in Fig. 358A). The descending sensory root passes down on the outer side of, and somewhat dorsally to, the above-mentioned nuclei, forming a marked feature in the transverse sections through the mesocephalon (*V.D.* in Fig. 358D, *d.V.* in Fig. 358J). This sensory root joins the upper part of the motor root.

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* This nucleus is placed in Fig. 358A, on the *left* side, as a *sensory* nucleus. The point is of course debatable, as is almost everything in physiology, and of course in Anatomy, as soon as Anatomy is made to rest on physiological research. The difficulty of distinguishing between the nuclei of a mixed nerve is evidently considerable. The Author has followed the views of Duval. The serial sequence explained goes a long way to show the motor character of the fasciculus solitarius.

The middle sensory nucleus (V.S. in Fig. 358A, N.V.S. in Fig. 358I)* is a small one situated externally to, a little below, and somewhat deeper than, the motor

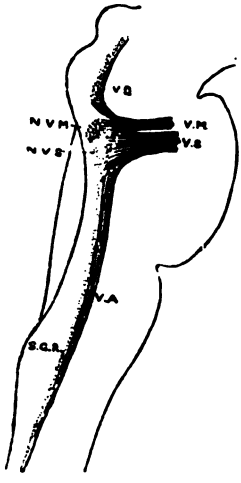

FIG. 358I.—SAGITTAL SECTION THROUGH MEDULLA, PONS, TUBERCULA, AND CRURA, SHOWING THE NUCLEI AND ROOT-FIBRES OF THE FIFTH NERVE. (Quain.)

V.M., V.S., motor and sensory portions of the nerve; V.D., descending sensory root (the accompanying dots represent the corresponding nucleus); N.V.M., motor nucleus, with N.V.S., upper sensory nucleus, just below it; S.G.R., substantia gelatinosa of Rolando, forming the lower sensory nucleus; V.A., corresponding ascending sensory root.

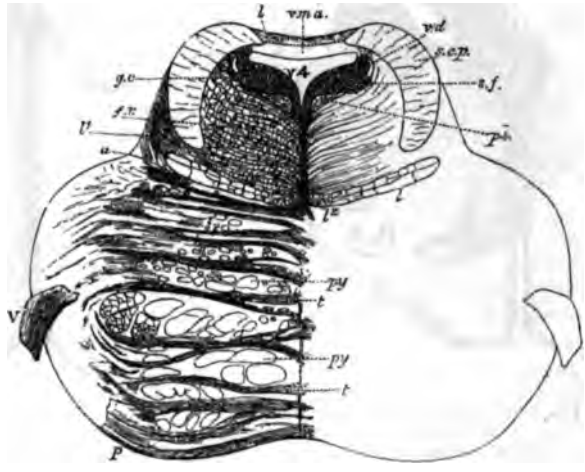

FIG. 358J.—TRANSVERSE SECTION THROUGH UPPER PART OF PONS, SHOWING DESCENDING ROOT OF FIFTH NERVE, *v.d.* (Quain, after Stilling & Schwalbe.)

nucleus; it gives off but a small number of the fibres; these are joined inferiorly by the main bundle of sensory fibres derived from the lower sensory nucleus.

The lower sensory nucleus lies in the cells of the substantia gelatinosa of Rolando, a long way down the medulla (S.G.R., Fig. 358I). From it there ascends the large ascending sensory root, which is such a prominent feature in the transverse sections of the medulla (See *a. V.*, Figs. 358K, L, N, & *V.a.*, Fig. 358M). This ascending root passes up, capping in section the substantia gelatinosa of Rolando, and joins inferiorly the fibres from the middle sensory root.

* This nucleus is termed the *upper* sensory nucleus in Quain's Anatomy (Tenth Ed.), in which work the character of the descending root and corresponding nucleus on the floor of the Sylvian aqueduct is not defined. That these parts are sensory would appear to be certain from the investigations of Duval. Hence the slightly altered designation (see Note, p. 152o).

FIG. 358K.—TRANSVERSE SECTION THROUGH LOWER PART OF MEDULLA (REGION OF THE PYRAMIDAL DECUSSATION), SHOWING ASCENDING ROOT OF FIFTH NERVE *a.V.* (Schwalbe.)

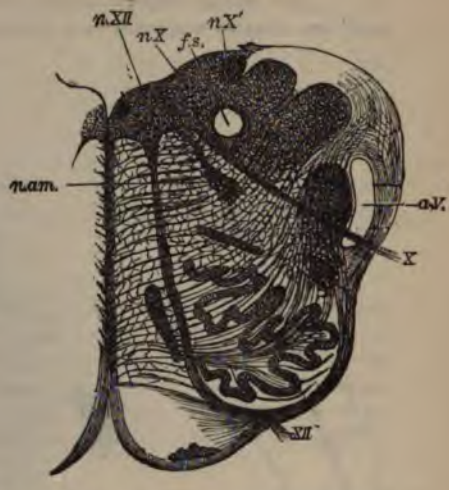

FIG. 358L.—TRANSVERSE SECTION THROUGH MIDDLE OF MEDULLA (LEVEL OF THE MIDDLE OF THE OLIVARY BODY), SHOWING SAME. (Schwalbe.)

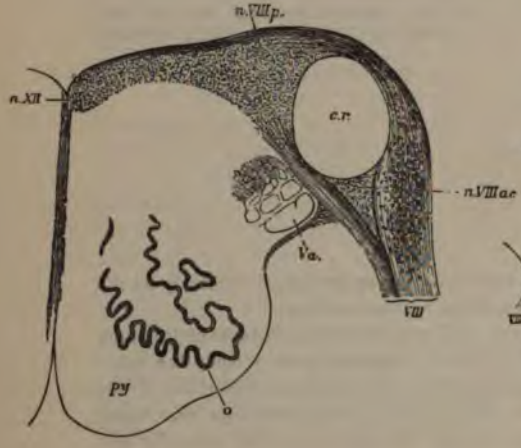

FIG. 358M.—TRANSVERSE SECTION THROUGH UPPER PART OF MEDULLA (LEVEL OF THE UPPER PART OF THE OLIVARY BODY), SHOWING SAME, MARKED *V.a.* (Schwalbe.)

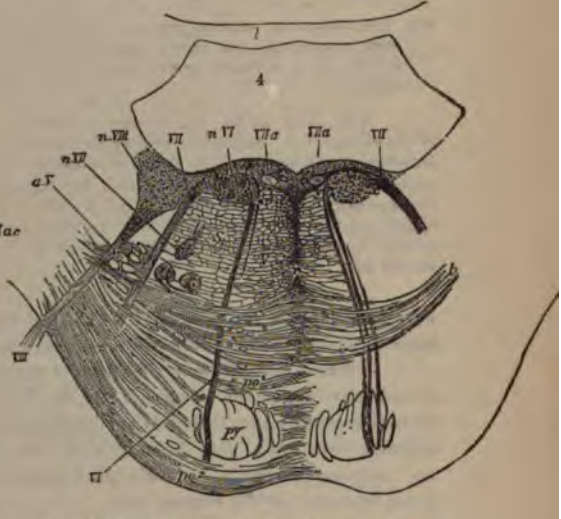

FIG. 358N.—TRANSVERSE SECTION THROUGH LOWER PART OF PONS, SHOWING SAME, MARKED *a.V.* (Quain, after Stilling & Schwalbe.)

The foregoing figures will be found fully described pp. 328 to 342. They are introduced here mainly to show the several roots of the fifth nerve; most of the other indications have been deleted.

Fig. 358B may now be referred to. It is an extremely clever drawing, though complicated and puzzling at first sight, since it sums up and co-ordinates practically all that has been previously said. It requires a little careful study; but with this it will be easily made out. It is a sagittal section, representing the same parts as Fig. 358A, and also supposed to be transparent.

At the upper part of the figure will be seen the nuclei of the third and fourth nerves (III., IV.) with the corresponding root-fibres passing to their respective points of emergence.

Dorsally to these will be seen the descending sensory root of the fifth nerve (V.d.).

Let the reader follow this down. It will be seen to lead to the upper sensory root (V.s.) and to the long or ascending sensory root (Va.), which, unfortunately, is not very plainly marked, but could not well be marked more plainly on account of the various details which have had to be superposed to it.

Ventral to the line of the sensory origins of the fifth nerve is the line of the motor origins (1) of the same nerve, (2) above, of the third and fourth nerves, and (3) below, of the glosso-pharyngeal and pneumogastric nerves (nucleus ambiguus). The nuclei of the third and fourth nerves (III., IV.) have already been seen. Let the reader carry on the line of these two nuclei parallel to, and ventral to, the descending root of the fifth nerve, and he will come upon the motor root of the fifth nerve (V.m.), somewhat concealed in its upper part by the common bundle of the sensory fibres of the same nerve. Let the reader continue the line a good deal lower down, through the nucleus and root-fibres of the auditory nerve (VIII.), and he will come upon the elongated motor nucleus (nucleus ambiguus) common to the glosso-pharyngeal and pneumogastric nerves (IX. & X., *n.a.*). This is quite distinct in its lower part, though in its upper part it is somewhat concealed, and unavoidably so, by the superposed facial, sixth, and auditory root-fibres. Now in the line of the motor nuclei of the fifth, glosso-pharyngeal, and pneumogastric nerves, below the nucleus of the fifth nerve, and above the nuclei of the glosso-pharyngeal and pneumogastric nerves, there will just be perceived, heavily overlaid, the nucleus of the facial nerve, marked VII. It is overlaid, and again unavoidably so, by the root-fibres of the sixth and auditory nerves. This nucleus of the facial nerve will be seen to be the starting point of a kind of figure of interrogation laid flat ( ). This is the intra-pontine portion of the facial nerve. In the ring of the figure of interrogation is the nucleus of the sixth nerve (VI.), whose root-fibres cross both the nucleus and the root-fibres of the facial nerve. (This part of Fig. 358B will make plain the statements as to the deep origin of the facial nerve and the fasciculus teres, pp. 152m & 152n.)

Below the nuclei of the glosso-pharyngeal and pneumogastric nerves, almost in a line with them, and crossed, as explained below, by the lower part of the nucleus of the hypoglossal nerve (XII.), is the upper part of the nucleus of the spinal accessory nerve (XI.).

There will thus be seen to lie ventrally in the medulla, and in a line from below upwards, the motor nuclei, first of the spinal accessory, then of the pneumogastric and glosso-pharyngeal (nucleus ambiguus), then of the facial nerve, then of the fifth nerve, and finally, after a considerable interval, those of the fourth and third nerves.

The motor root-fibres of the facial, glosso-pharyngeal, and pneumogastric nerves are seen to run dorsally, – those of the glosso-pharyngeal and pneumogastric nerves to reach the sensory nucleus of these nerves (only marked IX., as it was scarcely possible to put in an X anywhere where it could well be seen). The conjoined root-fibres from these

nuclei are then shown as they begin to turn outwards; but they have been cut short, as otherwise they would have had to cross the structures previously named, further adding to the complication of the figure.

The course is clearly shown in the figure of the elongated nucleus of the hypoglossal nerve, as traced in the lower, or covered, part of the medulla, and in the lower part of the floor of the fourth ventricle, and lying in succession from below upwards ventro-externally, externally, dorsally, and dorso-internally, both to the ascending root of the fifth nerve and to the nucleus of the spinal accessory.

DISSECTIONAL ANATOMY AND PAPER ANATOMY.

The whole range of anatomy, as now understood by many, could probably afford no better illustration than that presented by the description of the deep origins of the cranial nerves, of what, *for the medical student and the medical man*, anatomy, to the Author's mind, should *not* be. No problem can well be conceived more interesting than that of the deep, or *real*, origins of the cranial nerves, or as to which the latest data of successful research should be placed more fully, and more carefully, before the intelligent reader. There is no shadow of a suggestion, therefore, of setting the subject aside. But the questions are pressed, Do such points belong to the kind of anatomy which should be placed side by side with the anatomy of the biceps, or the brachial artery? Do they belong to that kind of anatomy which will teach the student to dissect and to learn things with his own eyes and his own hands? Do they belong to that kind of anatomy which, presented as *anatomy*, will do him any good? Or do they belong to that kind of anatomy (so-called) which, being learnt only from plates and diagrams, will take the student away from the dissecting room, and injure him as a *practical* man, and even ruin many – (if there is much anatomy of the kind; and there is more and more of it now-a-days) – in regard to the mere question of passing examinations?

Expressions of double significance have never led to good. If anatomy is to mean two things, – dissecting-room anatomy, and *paper* anatomy, – then one, clearly dissecting-room anatomy, must of a necessity be put in the background; for speculation is always more attractive than hard work.

This is taking place before our eyes. What is the meaning, otherwise, of the phrase "common or garden anatomy," which one now hears so often.

If work is to be done well, it must not be broken up into bits and fragments, especially into such as do not fit in with one another. One kind of work should be taken in hand continuously and steadily till it is done with. If our anatomy is to be dissecting-room anatomy, – and who can doubt for a moment that *this* is the *useful* anatomy for the *medical man?* – then, if the work is to be successfully carried out, we should first have dissecting-room anatomy *alone*, till such part of the curriculum is, as is the fashion now, examined in and set aside.

Then paper anatomy can be taken with advantage.

Or, better, paper anatomy can come in all along with physiology. What more akin to physiology than the work above recorded? Excellent work, and most interesting, work that cannot be too highly praised; but *laboratory work, not dissecting-room work;* work ever conducted by the physiologist, not by the anatomist in the usual sense of the term.

Will undeniable facts be looked in the face? In all the newer books of anatomy the description of each cranial nerve *begins with the description of its deep origin.* This necessarily strikes the student as the first thing he should master. What, then, can he do, but puzzle through, and learn off more or less by heart, – *for he can see nothing,* – the statement which thus faces him at the onstart?

To do this he leaves the dissecting room. *Of what use being among the "parts" for work with which the "parts" have nothing in common?* And leaving the dissecting room to "get up," among other things, the deep origins of the cranial nerves, he contents himself with a rapid and careless dissection of the "head and neck" as a whole, or with looking over his neighbour's dissection. The writer sees men by hundreds who, when questioned as to their dissections, reply that they have done everything but the head and neck, – everything, that is, but that most difficult and most important part of all.

Students thus become deeply imbued with the view that all that is required of them in regard to anatomy is that they shall be able to recognise, or "spot," things when they are shown them, and to write and talk fairly about them. Now the stress of work aiming at the above objects lies, not in the direction of the so-called practical test of recognising, of "spotting," – this is quite an easy affair, a matter of mere "nodding acquaintance,"* – but in the direction of the writing and talking. The student's effort tends, therefore, in the direction of the information he finds already formulated in books, – in books to be learnt off more or less *by heart.*

What follows? Men leave more and more everything that ties them in any way. Why should they be troubled with supervision that cannot help them? *They can best get up the book-work in their own way.* And they thus get up the book-work,

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* What does the "spotting" test come to?

Given a student who has been mainly taught "paper anatomy," and who is shown, say, a dissected head and neck, he must know that the single large artery at the lower part of the anterior triangle is the common carotid; that, of the two large arteries at the upper part, the posterior one is the internal carotid, and the anterior one, the external carotid; similarly, counting from below upwards, that the anterior offshoots of the latter are respectively the superior thyroid, lingual and facial. However really ignorant

supporting it on the slenderest substructure of practical knowledge which will just do to prop it up for a time, – the "crammer" coming in here to cleverly bind together the "scaffolding of words" till the examination is passed, – when the whole thing is taken down and cleared away, like the bunting of holiday rejoicings. Rejoicings, if the student has "passed," that he will have nothing more to do with anatomy & physiology!

Pity on the poor patients!

But, if the student has not passed, the "house of cards" is again to be set up from foundations (?) to roof, again, perhaps, to be knocked down and set up again, knocked down and set up again.

The thing is in the spirit of the child with his nursery bricks. And as the child grows impatient, and "throws it up," if, more than once or twice, someone, just entering, shakes the room and causes the "tower of Babel" to fall, so the candidate, – the young man at the portals of a profession, passing through which should ennoble a life-time, – gives up all higher objects, and aims at standards lower and lower, at merely "qualifying" . . . qualifying for what?

And yet there are numbers, ever-increasing numbers, who have to retire, beaten back, disheartened, with squandered means and wasted youth, irreparable failures in the common struggle for life.

The Author's contention is that it is the *practical work* that pays, even from the low point of view of passing examinations.

To begin with, the man who has done his work practically is not to be bowled over through "nervousness."

Taking it that the rearing of the "scaffolding of words" is, through the present glut of details, an unavoidable evil, the rearing of the same on a basis of fact leads at least to this, that failure at the examination means but the knocking off of the crest of the superstructure, not the razing of the whole thing to the ground. It is

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he may be, he cannot mistake the internal jugular vein on the outer side of the common carotid artery, or the pneumogastric nerve between and behind the two vessels; the nerve entering obliquely the upper part of the sterno-mastoid he must recognise as the spinal accessory; the one running across the several vessels below the small oblique muscle at the upper part (the digastric) he must know to be the hypoglossal, &c., &c. The mere nodding acquaintance here implied by correct answers, proves nothing in regard to true knowledge.

Only contrast with the above the really practical test involved in making a man try his hand at dissecting. Only gauge the unasked questions which his handling of the knife immediately gives reply to. Is he really acquainted with the thin veil which the platysma throws over the whole region? You will see this at once by his preserving it entirely, or partly, through more or less careful removal of the skin, or his sweeping it away altogether, unnoticed and unthought of. Is he familiar with the nerves which lie beneath the platysma, and their whereabouts? You will know this directly by his careful raising, or otherwise, of the middle part of the external jugular vein (in search for the superficial cervical nerve), or cleaning of the upper part (in search for the great auricular nerve). Does he know about the sterno-mastoid artery, about the descendens noni nerve? You can judge of this unerringly by the care, or otherwise, bestowed on the first exposing of the large vascular trunks. Is he familiar with the windings of the superior thyroid artery? Has he in mind its superior laryngeal branch, and its accompanying superior laryngeal nerve? Watch here as to whether he mainly cuts, or tears. The inferior thyroid artery and recurrent laryngeal nerve, the middle cervical ganglion of the sympathetic, the trunk of the vertebral artery, &c., &c., are they to him realities or mere words? This will be manifest in the later stages of the knife and forceps test without two words being exchanged. Here crammer and crammed are nonplussed. As a result, one has, as examinees, or will have when the better methods of the past are once more resorted to, not the paper anatomists, not the talkers, but the future surgeons in the true sense of the term.

then some detail or other, not the structure as a whole, that has to be seen to prior to the next attempt. In this view, work for the examination harmonises *pretty closely* with work for work's sake and for the higher aims which measure the true standard of the medical man. Learning then becomes the sure and steady rise to the "level crossing," or, at the worst, to the "stile," – not the exhausting and, except for mere examinational ticketing, useless "running at the jumping-pole" which now prevails.

As prefatory to the study of the Head & Neck, there are introduced here the figures of the *apparent* origins of the cranial nerves, which will be seen to have a bearing on almost every section of the study. In Fig. 358P the numerals indicative of the several nerves are those of Willis's classification.

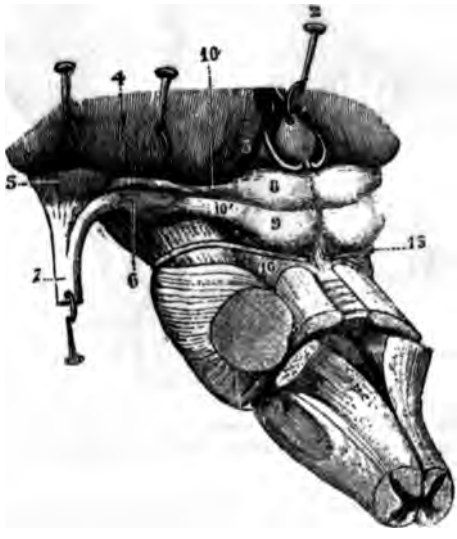


FIG. 358O.—THE MESOCEPHALON BEHIND, SHOWING THE APPARENT ORIGINS OF THE SECOND AND FOURTH NERVES. (Testut.)

8 and 9, anterior and posterior quadrigeminal bodies, with 10 and 10', their respective brachia; 5 and 6, internal and external geniculate bodies; 7, optic tract; 15, 16, apparent origin of fourth nerve from upper part of valve of Vieussens. (See expl., p. 355.)

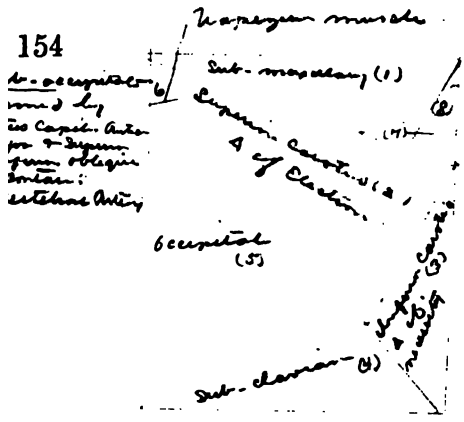
FIG. 358P.—MEDULLA, PONS, CRURA CEREBRI, AND OTHER CENTRAL PARTS OF THE BRAIN, SHOWING APPARENT ORIGINS OF THE CRANIAL NERVES, THE SECOND AND THE FOURTH EXCEPTED. (Allen Thomson, Quain.)

The nerves are marked in Roman figures, I. to IX., according to Willis's classification. II., optic nerve, with the optic tract, II.', and the internal and external geniculate bodies, *i*, *e*; III., third nerve or motor oculi; IV., fourth nerve, trochlearis or patheticus; V., the two roots, anterior small or motor, and posterior large or sensory, of the fifth nerve; VI., sixth nerve; VII., facial nerve, with the auditory nerve, marked *b*, to its outer side; VIII., pneumogastric nerve, with the glosso-pharyngeal nerve, marked *a*, above it, and the spinal accessory nerve, marked *b*, below it; *pa*, anterior pyramid; *o*, olivary body.

HEAD & NECK.

II.

POSTERIOR TRIANGLE OF THE NECK.



POSTERIOR TRIANGLE of the NECK.

Is bounded by sterno-mastoid, trapezius & clavicle.
Its floor is formed from above downwards by splenius capitis, levator anguli scapulæ, posterior & middle scaleni, and superior digitation of serratus magnus; – a part of the complexus is sometimes seen above the splenius.
It is divided by posterior belly of omo-hyoid into:

Sup. or Occipital Portion – The largest, contains:
Superficial cervical plexus & spinal accessory nerve,
Transversalis colli artery & vein,
Fat & lymphatic glands.

Inf. or Clavicular Portion – The smallest. Its size varies greatly with the extent of clavicular attachments of sterno-mastoid & trapezius, situation of omo-hyoid, and elevated or depressed position of shoulder. Contains:
Third part of subclavian artery,
Brachial plexus,
Transversalis humeri & transversalis colli vessels,
External jugular vein,
Fat & lymphatic glands.

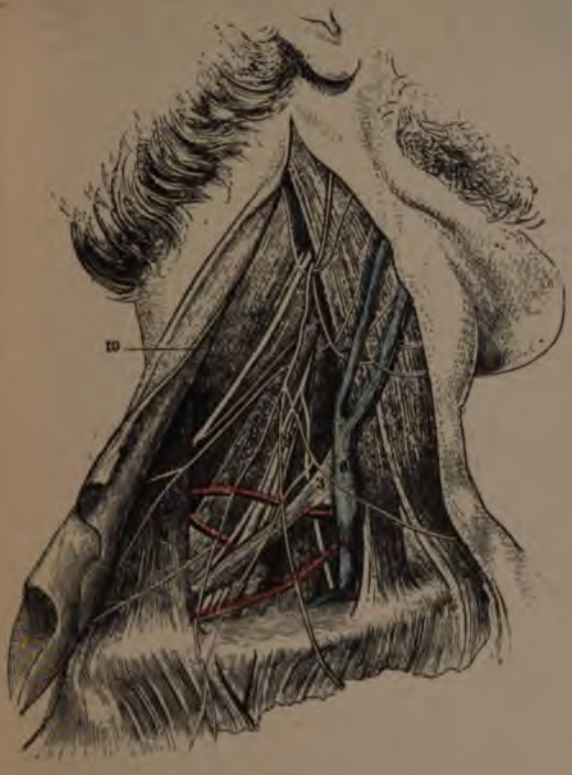


FIG. 358.—THE POSTERIOR TRIANGLE OF THE NECK. (Ellis.)

1, 2, 3, 4, 5, 6, the sterno-mastoid, trapezius, omo-hyoid, scalenus anticus, levator anguli scapulæ, and splenius; 7, subclavian artery; 8, external jugular vein; 9, brachial plexus; 10, spinal accessory nerve.

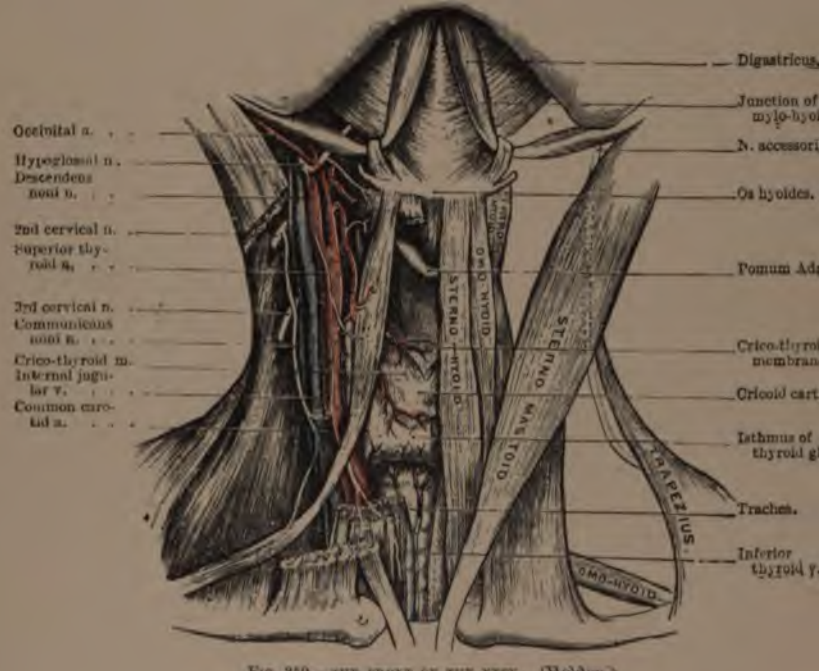


FIG. 359.—THE FRONT OF THE NECK. (Holden.)

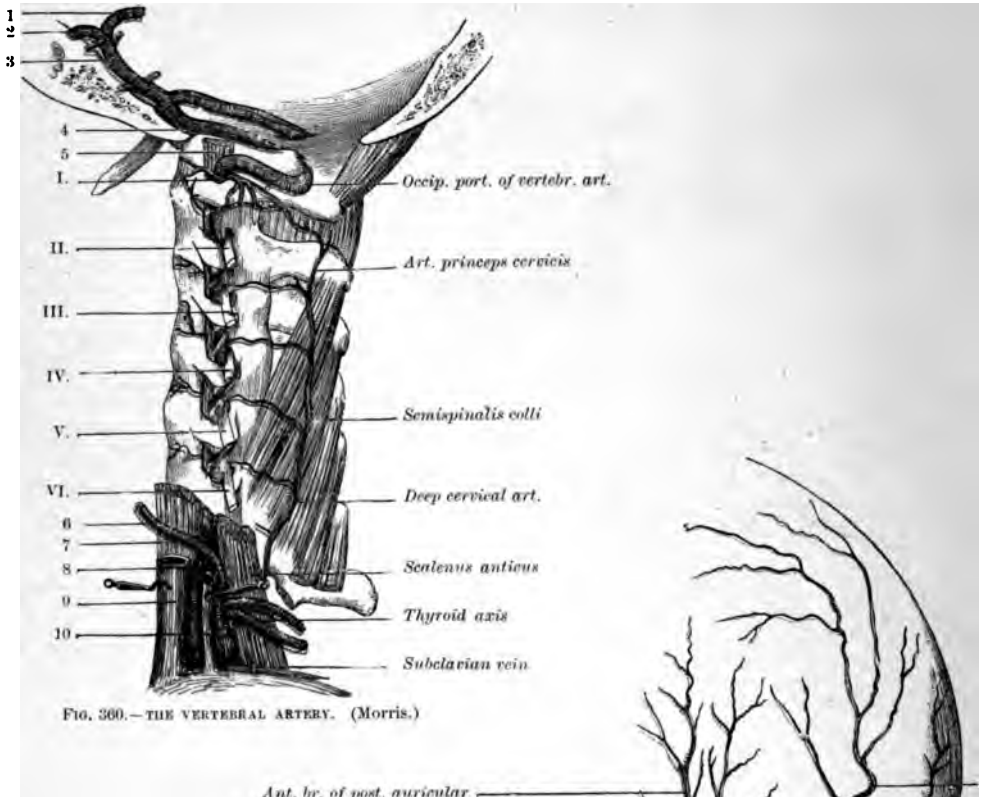


FIG. 360.—THE VERTEBRAL ARTERY. (Morris.)

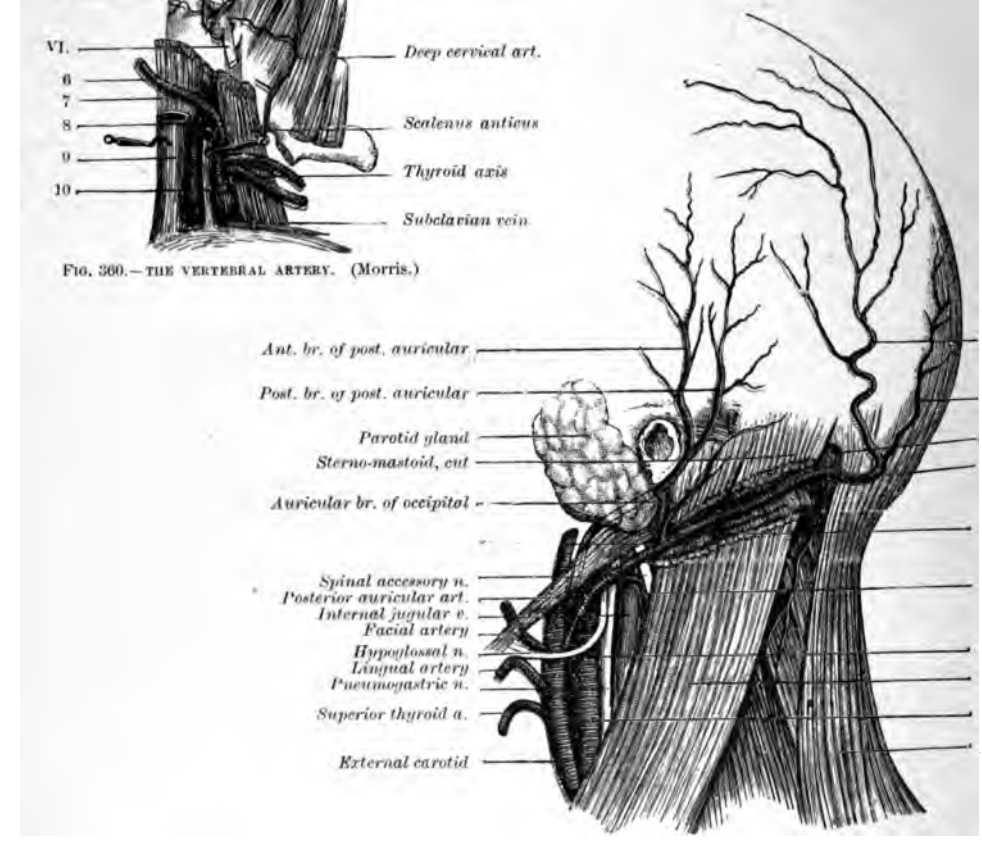


FIG. 361.—THE OCCIPITAL ARTERY. (Morris.) (See expl., p. 2280.)

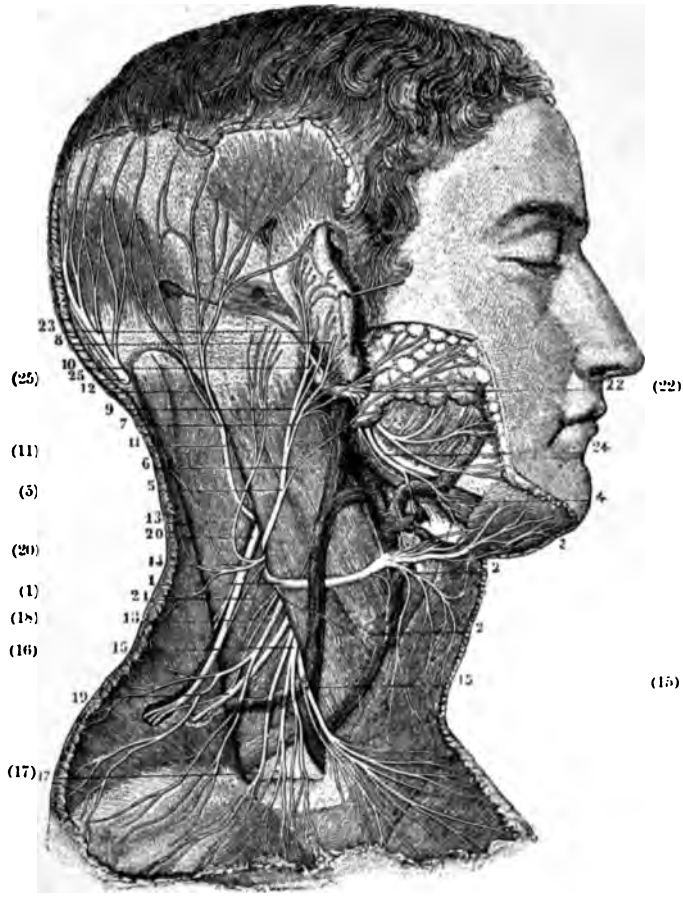


FIG. 362.—THE SUPERFICIAL BRANCHES OF THE CERVICAL PLEXUS. (Sappey, Hirschfeld.)

(1) Superficial cervical nerve;
- 2, its inferior branch;
- 3, its superior branch;
- 4, its union with the facial.

(5) Great auricular nerve;
- 6, one of its facial branches;
- 7, its branch to the lobule;
- 8, twig which pierces the auricle to pass to its outer surface;
- 9, branch to the deep surface of the pinna;
- 10, its union with the posterior auricular branch of the facial nerve.

(11) Small occipital nerve;
- 12, its branch which unites with the great occipital nerve;
- 13, a mastoid branch arising separately from the plexus;
- 14, twigs from this to the back of the neck.

(15, 16, 17, 18) Sternal, clavicular, & acromial superficial descending branches of the cervical plexus;
- 19, branch of the cervical nerves passing into the trapezius muscle.

(20) Spinal accessory distributed to the same and receiving a uniting branch from the cervical nerves;
- 21, branch to the levator scapulæ.

(22) Trunk of the facial nerve;
- 22, its posterior auricular branch passing into the occipital and posterior and superior auricular muscles;
- 24, its cervical branch.

(25) Great occipital nerve.

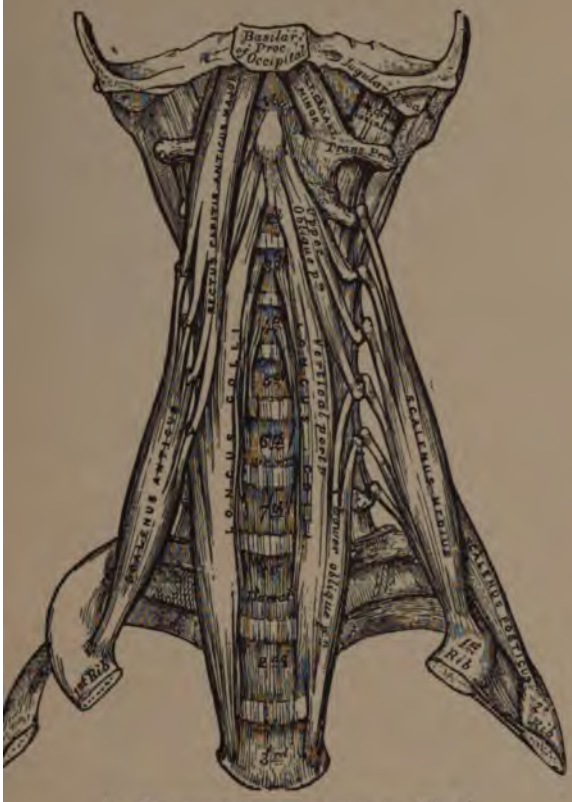


Fig. 363.—THE PREVERTEBRAL MUSCLES. (Gray.)

Fig. 364.—THE ROOTS & COMMUNICATIONS OF THE SEVENTH, NINTH, TENTH, ELEVENTH TWELFTH, & SYMPATHETIC NERVES. (Hirschfeld.)

(See expl., p. 228k.)

MUSCLES.

Platysma Myoides – Clavicle, acromion, fascia over pectoralis major, deltoid, trapezius.

Innermost fibres decussate below chin & in front of symphysis; othe are inserted into lower jaw below external oblique line; others blend wi depressores labii inferioris & anguli oris and the other muscles of the mout forming risorius. – S. by superficial cervical plexus and facial nerve.

Sterno-Cleido-Mastoid or Sterno-Mastoid.

STERNAL PORTION – Upper & outer part of front of first piece of sternum.

CLAVICULAR PORTION – Anterior surface & upper border of inner third of clavicle.

Anterior border & outer surface of mastoid process and outer two-thir of superior curved line of occipital bone. – S. by deep external branches cervical plexus & by spinal accessory nerve.

Trapezius – External occipital protuberance & inner third of superior curved line occipital bone; ligamentum nuchæ & spinous processes of the last cervical & of the dorsal vertebræ; supraspinous ligament.

Posterior border of outer third of clavicle, inner border of acromio whole length of upper lip of posterior border of spine of scapula, a tubercle at outer part of smooth surface at its inner extremity. – S. by spi accessory nerve & deep branches of cervical plexus.

Levator Anguli Scapulæ – Posterior tubercles of transverse processes of the 3, 4, o upper cervical vertebræ between splenius and scalenus medius.

Posterior border of scapula between spine and superior angle. – S. by one the deep branches of the cervical plexus and by one of the supra-clavicu branches of the brachial plexus.

Splenius – Lower half of ligamentum nuchæ and spinous processes of 7th cervical & upper dorsal vertebræ.

SPLENIUS CAPITIS – Mastoid process and outer part of rough surface between s erior & inferior curved lines of occipital bone.

SPLENIUS COLLI – Posterior tubercles of transverse processes of the 2, 3, or 4 upper c vical vertebræ – S. by external branches of posterior divisions of cervical nerves.

Scalenus Anticus – Tubercule on inner border and upper surface of 1st rib.

Anterior tubercules of transverse processes of 3rd, 4th, 5th, and 6th cervi vertebræ. – S. by one of the supra-clavicular branches of brachial plexus.

Scalenus Medius – Upper surface of first rib behind groove for subclavian artery.

Posterior tubercles of transverse processes of six lower cervical verteb – S. by one of the supra-clavicular branches of brachial plexus.

Scalenus Posticus – Back of outer surface of 2nd rib.

Posterior tubercules of transverse processes of two or three lower cervi vertebræ. – S. by one of the supra-clavicular branches of brachial plexus.

CERVICAL PLEXUS.

Formed by anterior branches of four upper cervical nerves & loops connecting them, and lies benea
sterno-mastoid, in front of levator anguli scapulæ & scalenus medius & the four upper vertebr
Communicates through loop between 4th & 5th nerves with brachial plexus, and, through its de
communicating branches, with pneumogastric, spinal accessory, hypoglossal & superior cervic
ganglion of the sympathetic. – Its superficial branches communicate with facial & great occipita
Its branches are superficial & deep.

SUPERFICIAL BRANCHES — Wind round posterior border of sterno-mastoid one belc
the other in the following order, which is also the order in which they aris

Small Occipital – From 2nd cervical; variable in size & sometimes double.
Ascends behind sterno-mastoid to attollens aurem & posterior belly of occipit
frontalis, and perforates deep fascia to integument of back of side of head
upper part of back of pinna; its auricular branches being sometimes supplie
by great occipital. Joins with great occipital, great auricular, & posteri
auricular branch of facial. – The second small occipital, or smallest occipita
when it exists, arises from 3rd nerve, and sends twigs to back of neck

Great Auricular – From 2nd & 3rd cervical nerves.
Ascends upon sterno-mastoid & beneath platysma to near lobule of ear, where
divides into branches
AURICULAR – Several, large; to integument of back of pinna, joining with po
terior auricular branches of facial & pneumogastric. Some twigs suppl
outer surface of lobule, and one reaches outer surface of pinna throug
a fissure between antihelix & concha
MASTOID – To integument behind ear, joining with post. auricular branch of facia
FACIAL – To integument of face, and to parotid gland joining with facial.

Superficial Cervical – The largest; from 2nd & 3rd.
Crosses sterno-mastoid beneath platysma & external jugular vein, and divides into brs.
ASCENDING – Gives off an ascending twig to external jugular vein, joins wit
cervico-facial branch of facial, and, supplying platysma, pierces it t
integument of upper & front part of neck
DESCENDING – Pierces platysma to integument of lower & front part of neck.

Superficial Descending – Several large branches from 3rd & 4th.
Descend between sterno-mastoid & trapezius, and divide into branches:
STERNAL – Cross origin of sterno-mastoid to integument of front of chest a
far as middle line
CLAVICULAR – Cross clavicle (sometimes one of them perforates the bone) t
integument over pectoralis major & deltoid, communicating with cuta
neous branches of the superior intercostal nerves
ACROMIAL – Over acromion & clavicular origin of trapezius to integument c
outer & back part of shoulder

SPINAL ACCESSORY NERVE.

Consists of two portions, the portion accessory to the pneumogastric & the spinal portion.

PORTION ACCESSORY to the PNEUMOGASTRIC — The smaller.

Arises from *lateral tract of medulla oblongata below pneumogastric.* — Deep origin from grey nucleus on lower part of floor of 4th ventricle.

Joins ganglion of root of pneumogastric in jugular foramen by two or three filaments, and is entirely added to the pneumogastric below the ganglion of the trunk.

Assists in forming *pharyngeal, superior & inferior laryngeal brs.* of pneumogastric.

SPINAL PORTION — The larger.

Arises from *lateral column of cord as low as 5th or 6th cervical n.* — Deep origin from anterior horn of grey matter.

Ascends between ligamentum denticulatum & posterior roots of the spinal ns., and enters skull through foramen magnum.

Passes out through jugular foramen in same sheath as, and on outer side of, pneumogastric n. and behind glosso-pharyngeal, joining with accessory portion.

Backwards behind hypoglossal & pneumogastric, beneath and then behind internal jugular vein and digastric & stylo-hyoid muscles to upper part of sterno-mastoid.

Pierces deep fibres of sterno-mastoid, giving branches to it and joining in its substance with 3rd cervical nerve.

Crosses posterior triangle of the neck, joining with 2nd, 3rd, 4th & 5th cervical ns., and is distributed to under surface of trapezius.

SUBCLAVIAN ARTERY.

From innominate artery behind upper border of sterno-clavicular articulation (right side) from end of transverse portion of arch of Aorta (left side), to outer border of first rib
Divided into three parts:-

FIRST PART — From origin to inner border of scalenus anticus.

SECOND PART — Lies behind scalenus anticus at a somewhat variable level above clavicle. Short; forms higest part of arch described by the artery. – RELATIONS:
In Front – Scalenus anticus, subclavian vein, phrenic nerve.
Behind – Scalenus medius.
Above – Brachial plexus.
Below – Pleura.

SUBCLAVIAN VEIN lies below & in front of artery, from which it is separated by scalenus anticus.

BRANCHES — **Superior Intercostal** on right side; generally no branch on left side.

THIRD PART — From outer border of scalenus anticus to outer border of first rib. Crosses lower & inner part of posterior triangle of neck, lying in the small space bounded by omo-hyoid, clavicle & scalenus ant. – RELATIONS:
In front – Skin, superficial fascia, platysma, descending branches of superficial cervical plexus, deep fascia, transversalis colli vein.
Clavicle, subclavius & its nerve, transversalis humeri vessels, external jugular vein with the plexus frequently formed by the suprascapular & transversalis colli.
Behind – Scalenus medius.
Above – Brachial plexus, omo-hyoid.
Below – Outer surface of first rib.

SUBCLAVIAN VEIN lies below, in front, & to inner side of artery.

BRANCH — Frequently the **Posterior Scapular,** which is otherwise derived from the transversalis colli.

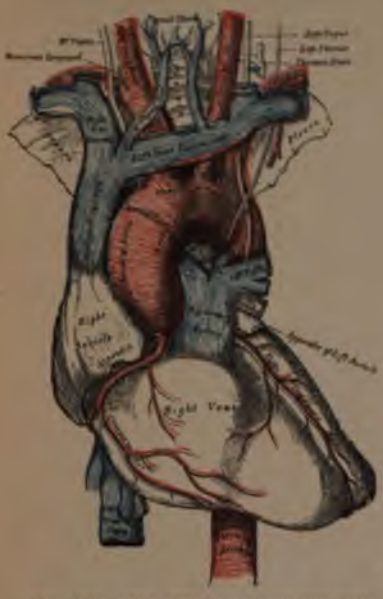


FIG. 364A.—THE DEEP VESSELS OF THE ROOT OF THE NECK. (Gray.)

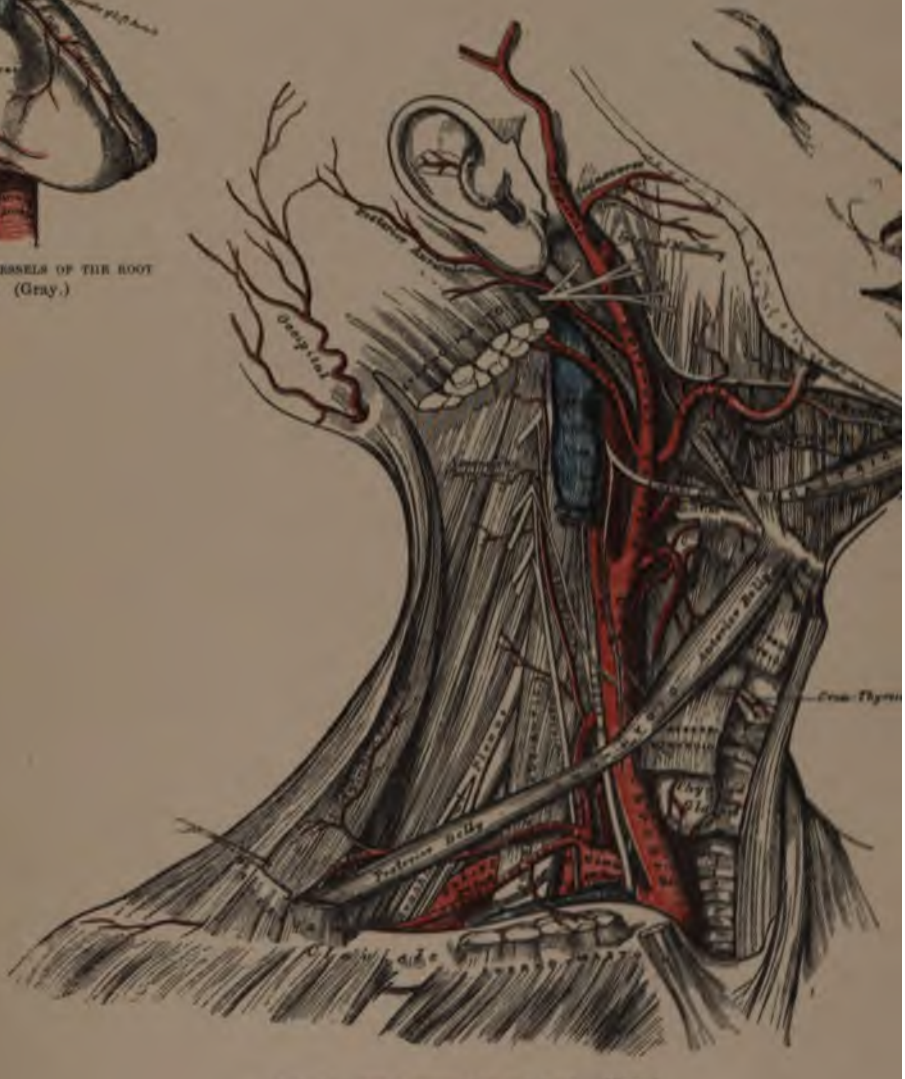


FIG. 365.—THE TRIANGLES OF THE NECK. (Gray.)

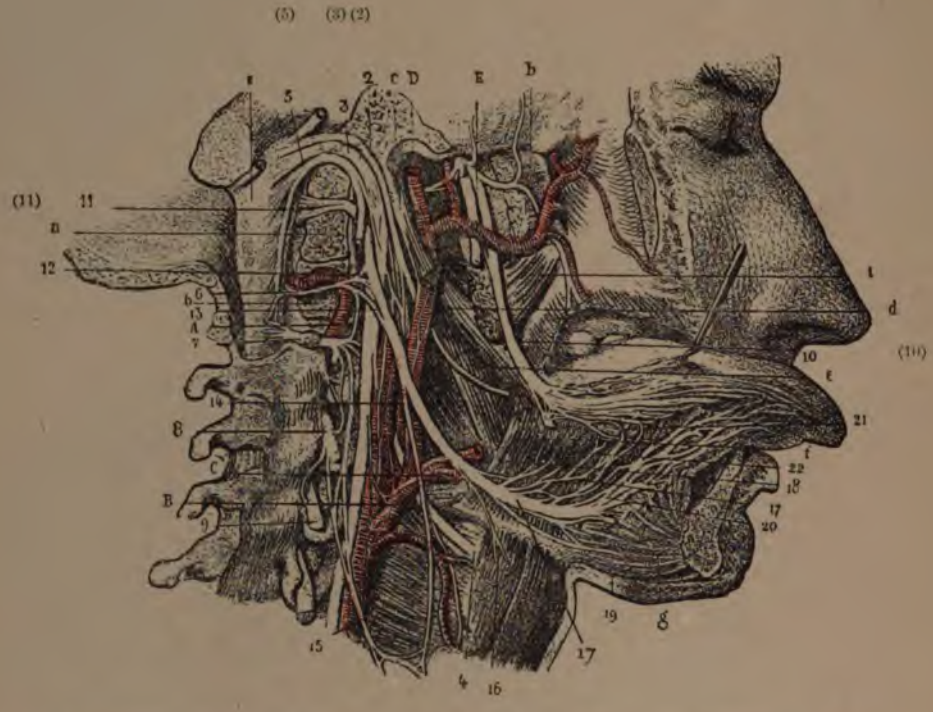


Fig. 366.—ORIGINS OF THE 9TH, 10TH, 11TH, & 12TH NERVES; NERVES SUPPLYING THE TONGUE. (Hirschfeld.)

1, the medulla oblongata, showing its lateral aspects.
(2) **glosso-pharyngeal nerve.**
(3) **pneumogastric nerve**; its superior laryngeal branch, 4.
(5) **spinal accessory nerve**;
6, 7, 8, 9, the four first cervical nerves; the two first are thoroughly exposed, and show the ganglia on their posterior roots, - that of the first nerve being quite small.
(10) **Lingual or gustatory nerve.**
(11) **Hypoglossal nerve** at its origin, and then passing through the anterior condyloid foramen, and between the spinal accessory & pneumogastric nerves;
12, 13, its anastomoses with the first and second cervical nerves;
16, its branch to the thyro-hyoid;
17, 18, 19, 20, its branches to the muscles of the tongue, including its recurrent branch to the stylo-glossus and its loop-like anastomosis with the gustatory;
14, 15, descendens and communicans hypoglossal nerves.

(See expl., p. 228k.)

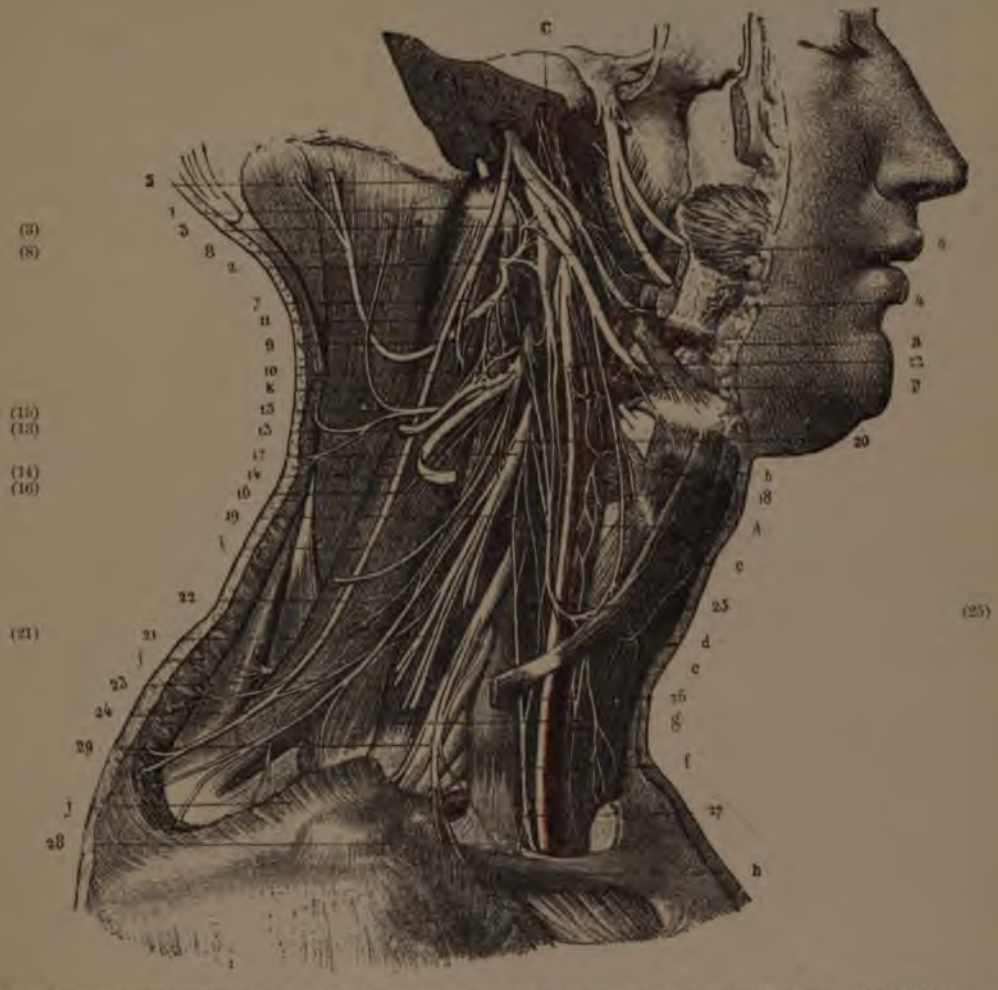


FIG. 367.—THE SPINAL PORTION OF THE SPINAL ACCESSORY NERVE, AND THE ORIGINS OF THE CERVICAL PLEXUS. (Hirschfeld.)

(16) Spinal portion of the spinal accessory nerve traversing the posterior triangle of the neck and joining with the second, third, fourth, and fifth cervical nerves, – the junction with the latter being somewhat concealed by the lower and front part of the trapezius;

1, 2, 10, 17, anterior divisions of the four first cervical nerves.

(3) Loop between the two first cervical nerves, and its anastomoses with the hypoglossal nerve, 4; pneumogastric nerve, 5, and the superior cervical ganglion of the sympathetic, 6;

7, 12, 18, origins of the descendens cervicis from the second, third, and fourth cervical nerves respectively.

(8) Small occipital nerve, arising from the second cervical nerve.

(13, 14) The great auricular and superficial cervical nerves, arising from the second and third cervical.

(15) Second small occipital, or smallest occipital, arising from the third.

(21) Some of the superficial descending branches arising from the third & fourth;

22, 23, muscular branches to the levator anguli scapulæ and trapezius.

(25) Ansa hypoglossi, from the convexity of which branches are supplied to the omo- and sterno-hyoid & -thyroid;

26, its anastomosis with the **phrenic nerve,** 19 & 27;

28, anastomosis of the phrenic nerve with the nerve to the subclavius;

29, brachial plexus.

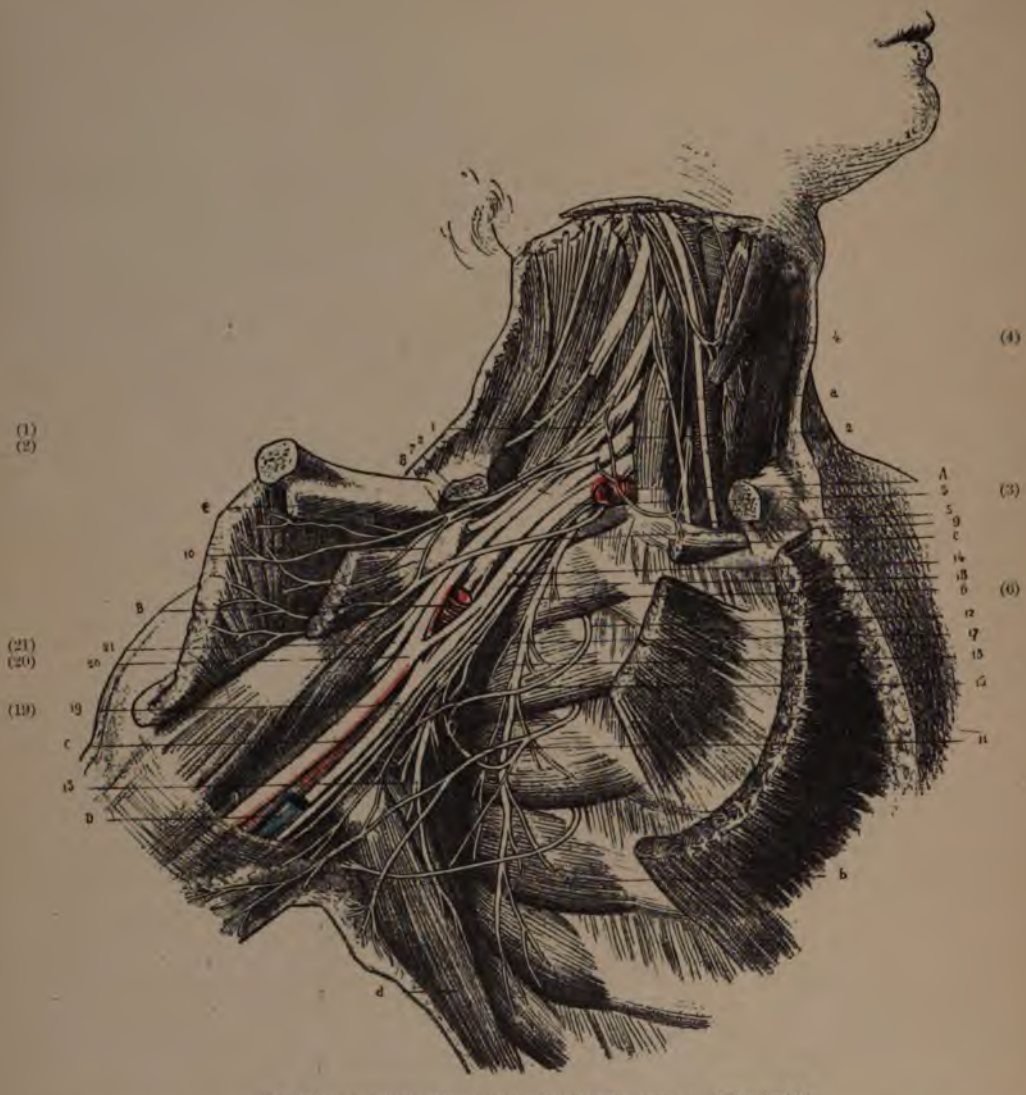


FIG. 368.—BRACHIAL PLEXUS AND NEIGHBOURING NERVES. (Hirschfeld.)

The clavicle has been sawn through near its sternal end, and is turned aside with the muscles attached to it; the subclavius and greater & lesser pectorals have been removed from the front of the axilla.

(1, 2, 3) **Anterior divisions of 5th, 6th, 7th, and 8th cervical nerves**; the anterior division of the first dorsal nerve is seen emerging from behind the subclavian artery, A.

(4) **Phrenic nerve**, joining with nerve to subclavius.

(6) **Posterior or long thoracic nerve**;
8, external anterior thoracic nerve, supplying pectoralis major, and joining with internal anterior thoracic nerve, 9, which supplies both pectorales;
5, nerve to subclavius;
7, suprascapular nerve;
11, 12, 13, upper, lower, and long subscapular nerves;
17, lesser internal cutaneous nerve, joining with intercosto-humeral nerve, 16;
18, internal cutaneous nerve,
17, lesser internal cutaneous nerve;

(19) **Ulnar nerve.**

(20) **Median nerve.**

(21) **Musculo-cutaneous nerve.**

THYROID AXIS.

Short thick trunk from front of first part of subclavian close to inn
border of scalenus anticus. Divides almost immediately into

Inferior Thyroid - Vide p. 293.

Suprascapular or Transversalis Humeri

Crosses lower part of scalenus anticus under cover of sterno-mastoid.
Outwards behind clavicle, beneath omo-hyoid.
Beneath trapezius, and over transverse ligament of scapula to supraspinous foss
where it ramifies between the muscle & the bon
Crosses neck of scapula to infraspinous fossa. - Anastomoses with the oth
scapular arteries, supplies shoulder-joint & subscapularis, and gives off
small supra-acromial twi

Transversalis Colli

Crosses upper part of subclavian triangle in front of scaleni & brachial plexu
passing sometimes between the trunks of the plexus, and divides beneat
trapezius int

SUPERFICIAL CERVICAL - Ascends beneath trapezius to muscles & glands of back
neck, and anastomoses with superficial branch of arteria princep
cervic

POSTERIOR SCAPULAR - Beneath levator anguli scapulæ to superior angle of scapul
and then along posterior border of the bone beneath rhomboidei as f
as its inferior angle, anastomosing with the other scapular arteries
the intercostals. Frequently arises from 3rd part of subclavia

BRACHIAL PLEXUS.

Formed as follows by anterior divisions of 5th, 6th, 7th, & 8th cervical and 1st dorsal nn.
Fifth & Sixth Cervical unite between anterior & middle scaleni, and form th
OUTER PRIMARY CORI
Eighth & First Dorsal unite behind scalenus anticus, and form the INNE
Seventh forms alone the MIDDLE PRIMARY CORD. [PRIMARY CORD
All three primary cords divide into *anterior & posterior divisions*.
Anterior divisions of *outer & middle* primary cords form the OUTER CORD.
Anterior division of *inner* primary cord forms the INNER CORD.
Posterior divisions of *all three* primary cords form the POSTERIOR CORD.

Broad between anterior & middle scaleni, where anterior divisions of the nerves li
above 2nd part of subclavian artery; contracted opposite clavicle, where inner &
outer cords lie at fore part of plexus on outer side of 3rd part of subclavian artery
& of 1st part of axillary; again expanded in axilla, where the three cords lie on
inner, outer & posterior aspects of 2nd part of axillary, and where they break up
into the large nerves of upper limb.

Communicates with the cervical plexus through loop between 4th & 5th nerves & through
branch from 5th nerve to phrenic, and with middle & inferior ganglia of sympathetic.

BRANCHES — Are

ABOVE THE CLAVICLE:

Post. or Long Thoracic, or Ext. Respiratory of Sir C. Bell – From
5th & 6th nerves, the two roots uniting in substance of sca-
lenus medius.
Deeply along side of chest behind axillary vessels & cords of brachial
plexus as far as lowest digitation of serratus magnus.

Suprascapular – From back of trunk formed by union of 5th & 6th.
Backwards & outwards beneath trapezius & through suprascapular
foramen to supraspinous fossa, where lies between supraspina-
tus & the bone
Round spine of scapula to infraspinous fossa. – Supplies supra- & infra-
spinati (two twigs to each), shoulder-joint & scapula

Muscular – To rhomboidei & frequently to levator anguli scapulæ (from 5th
nerve), subclavius (from 5th & 6th, anastomoses frequently
with phrenic), scaleni & longus colli (variably from 6th 7th &
8th.

Communicating – From 5th cervical to phrenic on anterior scalenus.

BELOW THE CLAVICLE — The branches are given off from the three cords
as follows, from

Outer Cord – External anterior thoracic, outer head of median, mus-
culo-cutaneous or external cutaneous

Inner Cord – Internal anterior thoracic, inner head of median, ulnar
internal cutaneous, lesser internal cutaneous or n. of Wrisberg

Posterior Cord – The three subscapular nerves, musculo-spiral &
circumflex

HEAD & NECK

II.

ANTERIOR TRIANGLE OF THE NECK

ANTERIOR TRIANGLE of the NECK.

Is bounded by sterno-mastoid, middle line of neck, lower border of jaw & line from angle of jaw to mastoid process.

It is divided by anterior belly of omo-hyoid, and by stylo-hyoid & posterior belly of digastric into:

Inf. Carotid Triangle – Bounded by sterno-mastoid, anterior belly of omo-hyoid, & middle line of neck; contains beneath sterno-hyoid & -thyroid:

Common carotid artery, internal jugular vein, pneumogastric & sympathetic;
Inferior thyroid artery, recurrent laryngeal nerve;
Trachea, thyroid gland, lower part of larynx.

Sup. Carotid Triangle – Bounded by sterno-mastoid, anterior belly of omo-hyoid, stylo-hyoid & posterior belly of digastric; contains:

Termination of common carotid artery, internal & external carotid arteries, & first branches of the latter;
Superior thyroid, lingual, facial, & internal jugular veins;
Pneumogastric, superior laryngeal, & sympathetic nerves:
Hypoglossal & descendens noni nerves.
Upper part of larynx, lower part of pharynx.

Submaxillary Triangle – Bounded by median line, jaw-bone & line from angle of jaw to mastoid process, and by stylo-hyoid & posterior belly of digastric; contains:

Submaxillary gland, facial artery & vein;
Submental artery, mylo-hyoid artery & nerve;
Lower part of parotid gland, facial nerve, external carotid artery with its posterior auricular, temporal & internal maxillary branches;
Internal carotid, internal jugular vein, pneumogastric, sympathetic all separated from external carotid by stylo-glossus & -pharyngeus & glosso-pharyngeal n.

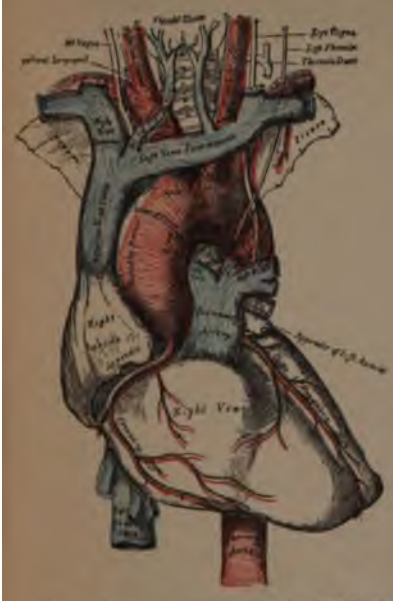


FIG. 368A.—THE DEEP VESSELS OF THE ROOT OF THE NECK. (Gray.)

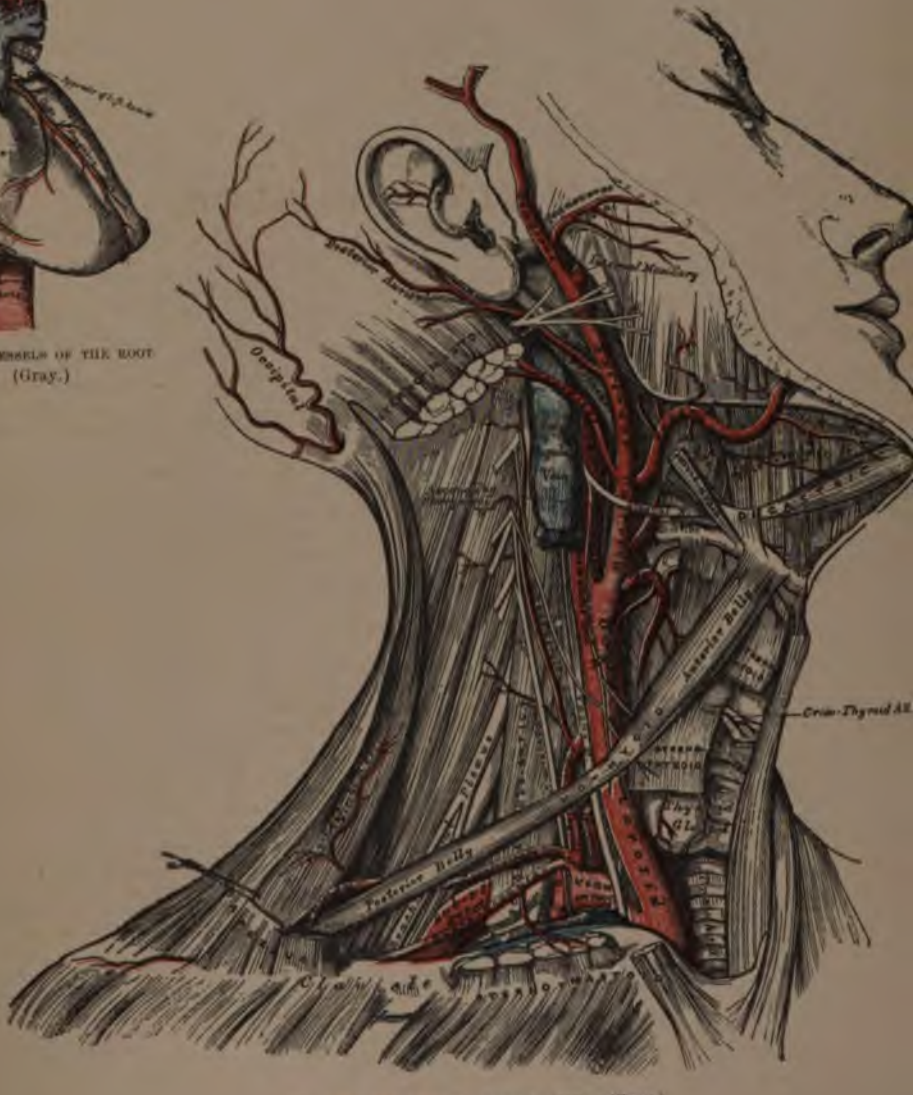


FIG. 369.—THE TRIANGLES OF THE NECK. (Gray.)

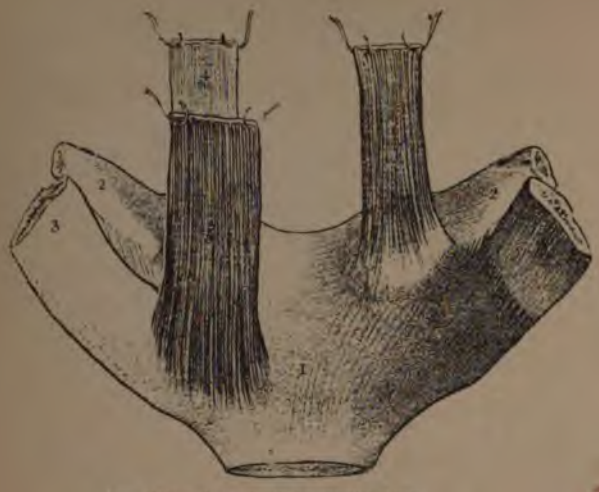


FIG. 363a.—4, 5, ORIGIN OF STERNO-CLEIDO-HYOID AND -THYROID; 1, 2, 3, STERNUM, CLAVICLE, & FIRST RIB, FROM BEHIND. (Jones, Quain.)

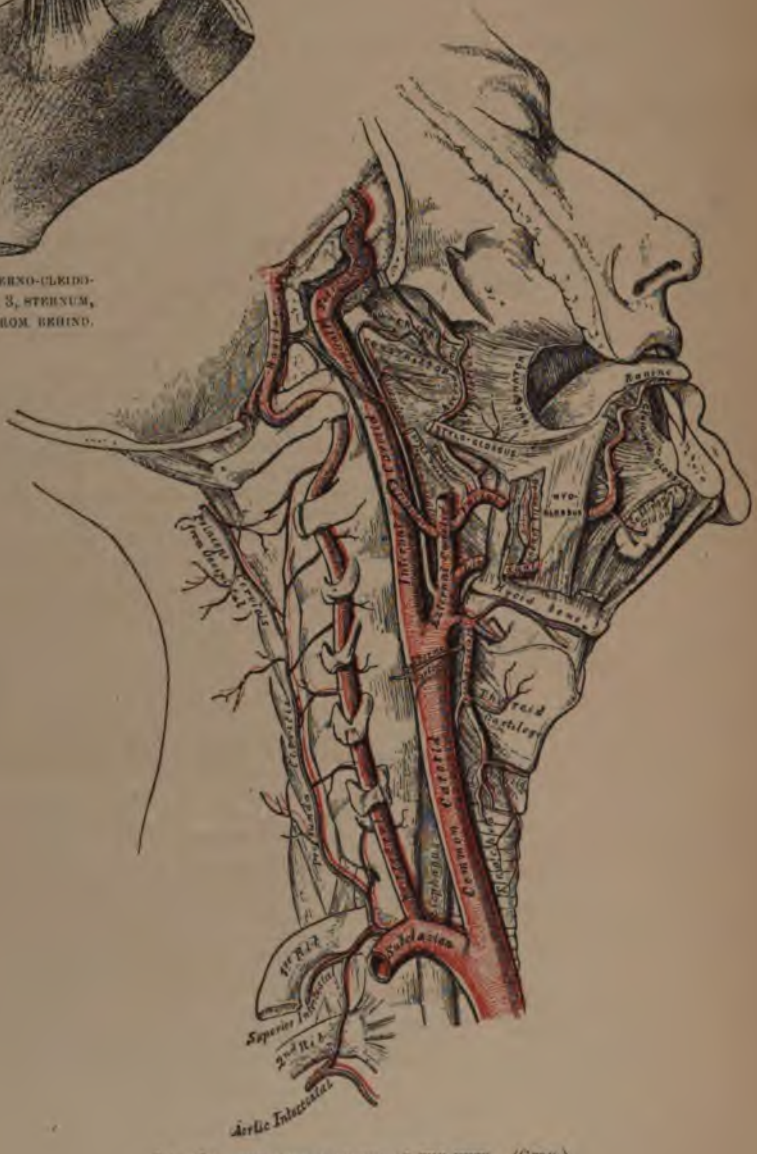


FIG. 370.—THE DEEP ARTERIES OF THE NECK. (Gray.)

MUSCLES.

INFRA-HYOID REGION.

Sterno-Hyoid or Sterno-Cleido-Hyoid – Variously from posterior sterno-clavicular ligament, and from upper & back part of first piece of sternum or back of inner extremity of clavicle, or from both; sometimes from clavicle only; occasionally from cartilage of first rib.
Lower border of body of hyoid bone internally to omo-hyoid. – S. by a branch from loop between descendens & communicans noni nerves.

Sterno-Thyroid – Back of first piece of sternum below & internally to sterno-hyoid.
Oblique line on ala of thyroid cartilage. – S. by a branch from same source.

Omo-Hyoid – Upper border of scapula on inner side of suprascapular notch and sometimes from transverse ligament.
Lower border of body of hyoid bone externally to sterno-hyoid. – S. by a branch from loop between descendens & communicans noni nerves.

Thyro-Hyoid – Oblique line on ala of thyroid cartilage.
Lower border of body & greater cornu of hyoid bone. – S. by hypoglossal n

SUPRA-HYOID REGION.

Digastric – Digastric groove on inner side of mastoid process. – Perforates stylo-hyoid and is held in connection with body & great cornu of hyoid bone by an aponeurotic loop lined with synovial membrane, from which loop it is reflected upwards & forwards to
Rough depression on inner lip of lower border of jaw bone close to symphysis. – S., posterior belly by facial nerve, anterior belly by mylo-hyoid branch of inferior dental nerve.

Stylo-Hyoid – Middle of outer surface of styloid process.
Body of hyoid bone at its junction with great cornu. – S. by facial nerve

Mylo-Hyoid – Whole length of mylo-hyoid ridge.
Body of hyoid bone & median raphé from hyoid bone to symphysis. – S. mylo-hyoid branch of inferior dental nerve.

Genio-Hyoid – Inferior genial tubercle.
Anterior surface of body of hyoid bone. – S. by hypoglossal nerve.

COMMON CAROTID ARTERY.

Right common carotid arises from innominate artery behind sterno-clavicular articulation.
Left common carotid arises from highest part of arch of Aorta, is longer, and has a thora
cic portion deeply situated within the thorax

THORACIC PORTION OF THE LEFT COMMON CAROTID ART.

Upwards & outwards to root of neck. — RELATIONS:
In Front — Sternum, sterno-hyoid & -thyroid, left innominate v., re
mains of thymus gland
Behind — Trachea, œsophagus, thoracic duct.
On Inner Side — Innominate artery.
On Outer Side — Left pneumogastric & phrenic ns. & left subclavian art.
left lung & pleura

CERVICAL PORTION OF THE COMMON CAROTID ARTERIES.

Upwards & outwards from behind sterno-clavicular articulation to upper border o
thyroid cartilage, where divides into external & internal carotid arts
Direction from sternal end of clavicle to midway between angle of jaw & mastoid pr
In same sheath of deep cervical fascia as int. jugular v. & pneumogastric n. Deeply
situated at origin; superficial at termination. — RELATIONS
In Front, *Lower part* — Skin, superf. f., platysma, ant. jugular v., deep f.
Sterno-mastoid, -hyoid, -thyroid, omo-hyoid, middle thyr. v
Upper part — Skin, superf. f. platysma, deep f., inner border o
sterno-mastoid
Sterno-mastoid art., facial, lingual & sup. thyroid veins
descendens noni n
Behind — Cervical vertebræ, longus colli, rectus capitis anticus major
inf. thyroid artery, sympathetic & recurrent laryngeal ns.
On Inner Side — Trachea, thyroid gland, larynx, pharynx; inferior thy
roid art., recurrent laryngeal n
On Outer Side — Internal jugular vein, pneumogastric n. — At lowe
part of neck int. jugular v. diverges from artery on right side
approaches and crosses it on left side

EXTERNAL CAROTID ARTERY.

From upper border of thyroid cartilage to interval between neck of condyle & external audi
tory meatus, where divides into temporal & internal maxillary
At its origin it is more superficial & nearer middle line than int. carotid. — RELA
TIONS
Covered by — Skin, superficial f., platysma, deep f., ant. border of sterno-mastoid
Lingual & facial veins, hypoglossal n., digastric & stylo-hyoid ms.
Parotid gl., facial n., junction of temporal & internal maxillary v
On Inner Side — Wall of pharynx, portion of parotid gland, sup. laryngeal n.
Behind — Sup. laryngealn., stylo-glossus & -pharyngeus, glosso-pharyngeal n., in
ternal carotid art

**BRANCHES: Superior Thyroid, Lingual, Facial;
Occipital, Post. Auricular; — Ascending Pharyngeal;
Temporal, Int. Maxillary.**

ANTERIOR BRANCHES of the EXTERNAL CAROTID.

SUP. THYROID — Arises from front of external carotid close to its origin beneath thin anterior margin of sterno-mastoid, and is quite superficial when this muscle is dissected from its sheath, for the latter then retracts and exposes the carotid vessels & their branches.

Tortuous course upwards & forwards, and then downwards & forwards beneath omo- & sterno-hyoid & -thyroid to anterior surface of thyroid body. Gives off brs:

Hyoid - Small; along lower border of hyoid bone beneath thyro-hyoid, and joins with its fellow.

Sterno-Mastoid or Superficial Descending - Descends to middle of sterno-mastoid, crossing carotid vessels.

Sup. Laryngeal - With superior laryngeal nerve to interior of larynx through outer part of thyro-hyoid membrane.

Crico-Thyroid - Small; crosses crico-thyroid membrane and joins with its fellow.

LINGUAL — Arises a little below hyoid bone beneath thin anterior margin of sterno-mastoid.

Upwards & forwards upon middle constrictor to great cornu of hyoid bone.

Horizontally forwards above great cornu beneath hyo-glossus, digastric & stylo-hyoid.

Upwards on genio--hyo-glossus.

Forwards with gustatory nerve on under surface of lingualis inferior, and then beneath mucous membrane to tip of tongue under name of ranine. - Gives off brs:

Hyoid - Small; along upper border of hyoid bone and joins with its fellow.

Dorsalis Linguæ - Ascends on genio--hyo-glossus to dorsum of tongue, epiglottis, soft palate & tonsil.

Sublingual - Forwards between mylo-hyoid & mucous membrane to sublingual gland.

Ranine - The terminal branch; joins with its fellow at tip of tongue.

FACIAL — Arises above preceding beneath thin anterior margin of sterno-mastoid.

Forwards & upwards beneath posterior belly of digastric & stylo-hyoid & submaxillary gld.

Crosses jaw bone in front of masseter.

Forwards and upwards to angle of mouth upon buccinator & beneath platysma.

Upwards beneath zygomatici and upon levator anguli oris and the levators of the lip & ala of the nose to inner canthus, where becomes angular artery and joins with ophthalmic.

Is very tortuous in its course. Facial vein lies behind it, and is less tortuous. Gives off branches:

Inferior or Ascending Palatine - Dips beneath ramus of jaw. Ascends between stylo-glossus & -pharyngeus and then upon superior constrictor in front of ascending pharyngeal, and supplies tonsil & soft palate.

Tonsillar - Ascends upon and perforates sup. constrictor to tonsil & root of tongue.

Submaxillary - Three or four, to submaxillary gland & surrounding muscles.

Submental - Forwards on under surface of mylo-hyoid, and between it and digastric to symphysis, where ascends upon chin.

Inf. Labial - Forwards beneath depressor anguli oris, below following artery to tissues of lower lip.

Inf. Coronary - Forwards beneath depressor anguli oris, and tortuous course through substance of orbicularis and between it & mucous membrane, anastomosing with its fellow.

Sup. Coronary - Larger and more tortuous; similar course along free edge of upper lip, giving twigs to ala and artery of septum to septum of nose.

Lateralis Nasi - To ala and dorsum of nose.

Angular - To inner canthus, supplying lachrymal sac and anastomosing with nasal branch of ophthalmic.

All these branches anastomose freely with each other, with those of the opposite side, and with the mental, transverse facial, infra-orbital, ophthalmic, sublingual, posterior superior or descending palatine and ascending pharyngeal arteries.

POSTERIOR BRANCHES of the EXTERNAL CAROTID.

OCCIPITAL — Arises just below posterior belly of digastric, and is crossed close to origin by hypoglossal ner
Upwards and backwards beneath posterior belly of digastric, stylo-hyoid, & portion parotid gland, crossing internal carotid artery, internal jugular ve glosso-pharyngeal, pneumogastric & spinal accessory nerves, – and th between mastoid process & transverse process of atl
Horizontally backwards in occipital groove beneath sterno-mastoid, digastric, spleni & trachelo-mastoid, – and then between trapezius & complex
Pierces upper part of trapezius, ascends beneath integument with great occipital ner and divides into numerous branches to upper & back part of hea
Gives off branche

Muscular – Numerous small ones, and one large one to upper part of stern masto

Auricular – To back of ear.

Meningeal – Through jugular foramen to dura mater of posterior fossa.

Arteria Princeps Cervicis – Descends beneath splenius, and divides int

SUPERFICIAL BR. – Descends between splenius & complexus, and anast moses with superficial cervical branch of transversalis col

DEEP BR. – Descends beneath complexus, and anastomoses with vertebr & with deep cervical branch of superior interost

POST. AURICULAR — Arises beneath or above digastric & stylo-hyoid, and ascen under cover of parotid gland & beneath facial nerve to groove betwe cartilage of ear and mastoid process, where divides in

Ant. & Post. Branches – Which communicate respectively with poster branch of temporal & with occipital, and of which the former gives numerous branches to back of ear. – Gives

Stylo-mastoid Art. (Sometimes derived from occipital). – Through sty mastoid foramen to tympanum & semicircular canals, joining with ty panic branch of internal maxillary, with which it forms in young su jects a vascular circle round membrana tympa

INTERNAL BRANCH of the EXTERNAL CAROTID.

ASCENDING PHARYNGEAL — Long, slender; from back of external caro near its orig

Ascends vertically to base of skull, in front of internal carotid artery and between th vessel & side of pharynx, giving off branche

External – Small, irregular, to 8th, 9th, and sympathetic nerves, and adjoini muscl

Pharyngeal – Three or four; to the three constrictors, stylo-pharyngeus, E tachian tube, soft palate & ton

Meningeal – To dura mater through foramina lacera posterius & medium, a sometimes through anterior condyloid foram

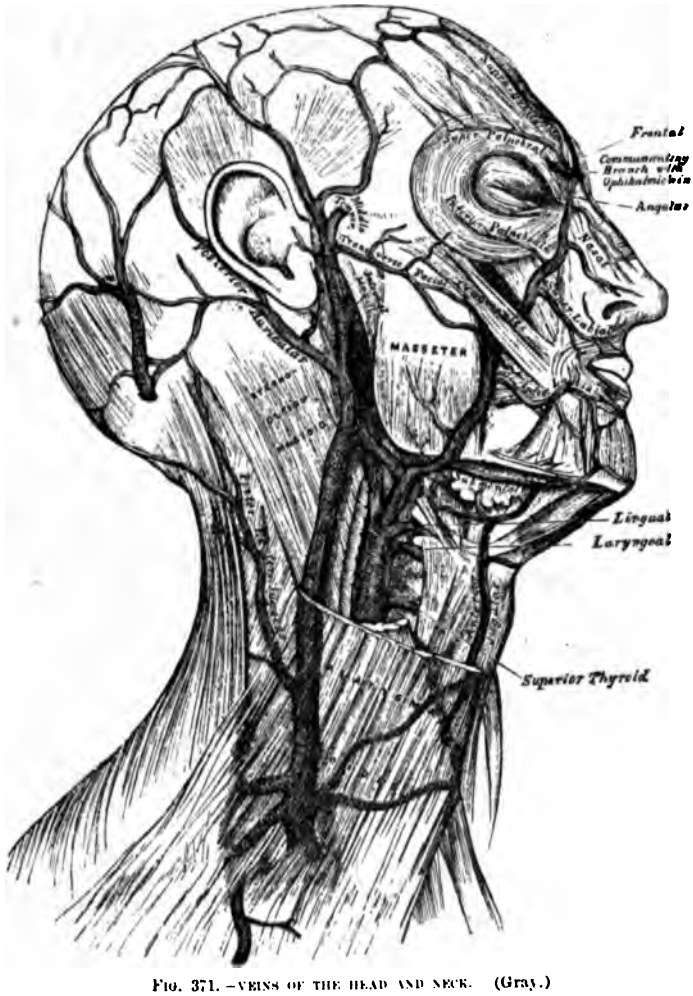


FIG. 371.—VEINS OF THE HEAD AND NECK. (Gray.)

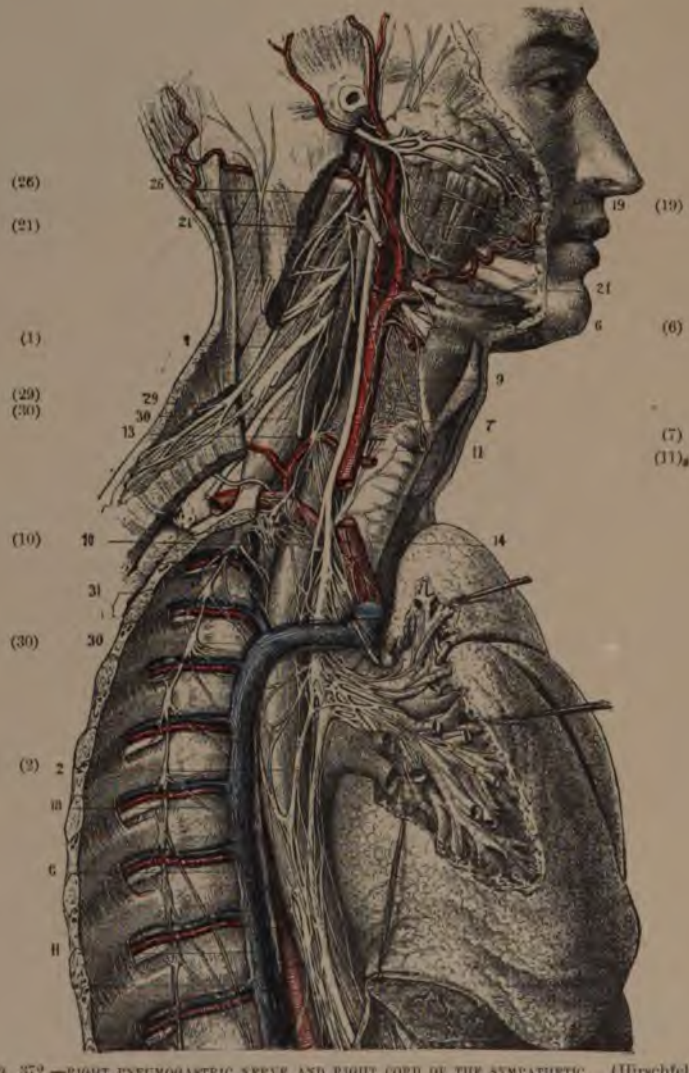


FIG. 372.—RIGHT PNEUMOGASTRIC NERVE AND RIGHT CORD OF THE SYMPATHETIC. (Hirschfeld.)

(1, 2) **Cervical and thoracic portions of the right pneumogastric nerve.**

(6, 7) **Superior laryngeal nerve** and its **external laryngeal branch**, the latter supplying the crico-thyroid.

(10, 11) **Inferior or recurrent laryngeal**, first winding round the first portion of the subclavian artery, and then entering the larynx beneath the inferior constrictor.

(23, 13) **Superior & middle cervical ganglia** of the sympathetic.

(12) Inferior cervical ganglion, deeply situated between the neck of the first rib and the transverse process of the last cervical vertebra;

31, thoracic ganglia;

9 & 14, superior & inferior cardiac branches of the pneumogastric;

16, posterior pulmonary plexus;

18, œsophageal plexus.

(19) **Glosso-pharyngeal nerve.**

(21) **Hypoglossal nerve**, divided.

(26 & 29) Spinal portion of the **spinal accessory nerve**;

30, 30, phrenic nerve, descending in front of scalenus anticus and in front of the root of the lung.

Fig. 373.—Left pneumogastric nerve and left cord of the sympathetic. (Sappey, Hirschfeld.)

(1) Pneumogastric nerve.

(2) Ganglion of its trunk :

3, accessory part of the spinal accessory ;

4, union of the pneumogastric with the hypoglossal ;

5, pharyngeal branch of the pneumogastric.

(6) Superior laryngeal nerve ;

7, external laryngeal ;

8, communication of the external laryngeal nerve with the superior cardiac branch of the sympathetic.

(9) Inferior or recurrent laryngeal :

10, superior, and 11, inferior cervical cardiac branches ;

12, 13, posterior pulmonary plexus.

(14) Lingual or gustatory nerve ;

15, distal part of the hypoglossal nerve.

(16) Glosso-pharyngeal nerve.

(17) Spinal accessory nerve, uniting by its inner branch with the pneumogastric, and by its outer passing into the sterno-mastoid muscle ;

18, second cervical nerve ;

19, third ;

20, fourth ;

21, origin of the phrenic nerve ;

22, 23, fifth, sixth, seventh, and eighth cervical nerves, forming with the first dorsal the brachial plexus ;

(24) Superior cervical ganglion of the sympathetic ;

(25) Middle cervical ganglion :

(26) Inferior cervical ganglion united with the first dorsal ganglion ;

27, 28, 29, 30, second, third, fourth, and fifth dorsal ganglia.

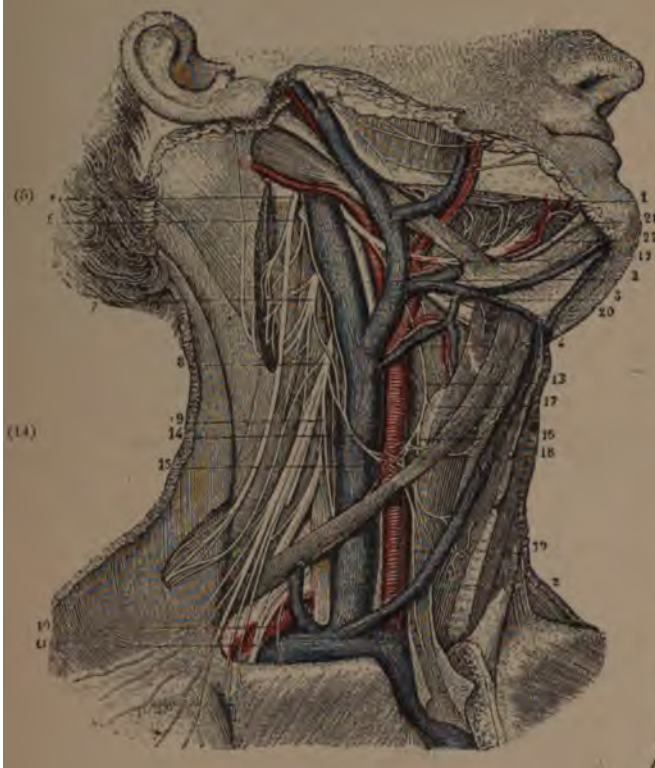


Fig. 374.—Distribution of lingual, hypoglossal, and spinal accessory nerves. (Sappey, Hirschfeld.)

1, lingual or gustatory nerve; 12, 22, hypoglossal nerve, with its branch to the thyro-hyoid, 20; 21, its anastomosis with the lingual; 13, descendens cervicis; 14, communicans cervicis; 15, 16, 17, 18, 19, branches from the ansa hypoglossi to the sterno-hyoid and -thyroid and omo-hyoid. (See expl., p. 228k.)

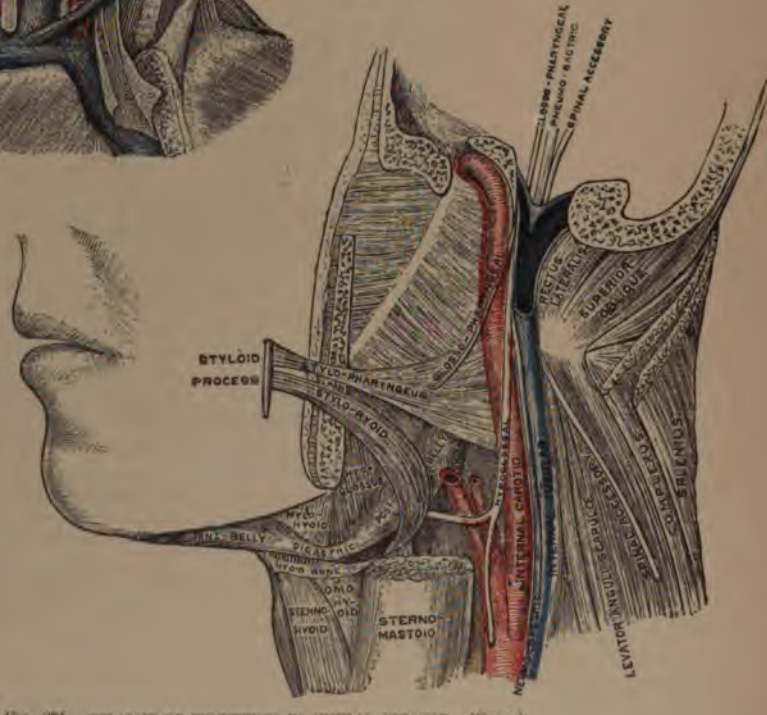


Fig. 375.—Relation of structures in jugular foramen. (Gray.)

VEINS of HEAD & NECK—1st Tablet.

ANTERIOR JUGULAR VEIN — Commences in submaxillary region and descends beneath platysma between sterno-mastoid & middle line of neck, and then deeply beneath sterno-mastoid, beneath which muscle it communicates with external & internal jugulars, and usually also with its fellow by a long & narrow transverse branch. Ends usually in subclavian close to external jugular, sometimes in terminal portion of external jugular. Receives

LATERAL TRIBUTARY BRANCHES: – A few *laryngeal veins* & sometimes an *inferior thyroid vein*. – Varies greatly in size, and is frequently absent on one side or other.

EXTERNAL JUGULAR VEIN — Formed by coalescence of temporal, internal maxillary, & posterior auricular, and commences in substance of parotid gland opposite angle of jaw. Descends perpendicularly over sterno-mastoid & along its posterior border, beneath platysma & over superficial cervical n., and, perforating deep fascia, opens into subclavian externally to internal jugular. Has two pairs of valves situated, one at its opening into subclavian, the other about an inch & a half above clavicle. – Receives

LATERAL TRIBUTARY BRANCHES: – *Suprascapular, Transversalis Colli, & Posterior External Jugular*, sometimes the *Occipital*; – and communicates with the anterior & internal jugulars, with the latter by a large branch in substance of parotid.

INTERNAL JUGULAR VEIN – The continuation of lateral sinus opposite jugular foramen, in which foramen it is expanded into the *gulf or sinus of the internal jugular vein*. Descends vertically, lying first on outer side of & a little behind internal carotid, then on outer side of common carotid, and finally, on the left side, on outer side & in front of common carotid, and, on the right side, externally to & at a certain distance from it, in front of first part of subclavian. The eighth & ninth nerves lie on inner side & in front of its sinus; lower down the spinal accessory crosses the vein posteriorly, and the glosso-pharyngeal & hypoglossal pass forwards on its inner side, between it and the internal carotid; the pneumogastric lies along whole of neck between & behind the two vessels; behind the vein are the recti capitis lateralis, anticus major, & the longus colli. – Joins subclavian behind sterno-clavicular articulation to form the innominate, a pair of valves being situated at or a little above its termination. – Receives

LATERAL TRIBUTARY BRANCHES: – *Occipital* (usually), *Facial, Lingual, Pharyngeal, Superior & Middle Thyroid*; – and communicates by a large branch with external jugular in substance of parotid.

CERVICAL PLEXUS.

Fig. 367 (p. 158e)

DEEP BRANCHES — Divided into internal & external.

INTERNAL — Are:

Communicating – From loop between 1st & 2nd cervical to pneumogastric, hypoglossal & superior cervical ganglion of sympathetic; and also from 3rd & 4th to cord & sympathetic below the ganglion

Muscular – From 1st & 2nd, to recti capitis antici major & minor, and rectus lateralis

Communicans Noni – From 2nd & 3rd.

Downwards & forwards across sheath of carotid vessels (sometimes within the sheath and then either in front of or behind internal jugular vein), and, near middle of neck, forms a loop with descendens noni; from convexity of which loop branches are given off to the sterno-hyoid & -thyroid and omo-hyoid

Phrenic or Int. Respiratory of Sir C. Bell – From 3rd, 4th, and usually also from 5th

Downwards & inwards in front of scalenus anticus.

Between subclavian vein & 1st part of subclavian artery crossing internal mammary and receiving a filament from sympathetic, sometimes another from 5th & 6th cervical nerves, and occasionally on the left side, one from the ansa hypoglossi

Crosses arch of Aorta & pulmonary artery, on the left side.

Descends, on the right side, on outer side of right innominate vein & sup. vena cava

In front of root of lung & along side of pericardium to diaphragm, and divides in to branches which perforate the diaphragm and supply it by its under surface

Both nerves give off twigs to the pericardium & pleura, and join with the phrenic plexus of the sympathetic, the right nerve sending also a few filaments to the diaphragmatic ganglion

EXTERNAL — Are:

Communicating – Join spinal accessory in substance of sterno-mastoid, in occipital triangle, & beneath trapezius

Muscular – To sterno-mastoid (from 2nd nerve), levator anguli scapulæ (from 3rd), scalenus medius & trapezius (from 3rd & 4th)

PNEUMOGASTRIC NERVE.

Arises from groove between olivary & restiform bodies below glosso-pharyngeal & above spinal accessory.

Through jugular foramen behind glosso-pharyngeal & in same sheath as spinal accessory.
Presents two ganglia, one in and one below jugular foramen:

SUP. OR JUGULAR G. OR G. OF THE ROOT — Small, greyish, rounded. Anastom. with *facial, glosso-pharyngeal, spinal accessory & sympathetic.*

INF. G. OR G. OF THE TRUNK — Reddish, cylindrical, nearly an inch in length. Anastom. with *hypoglossal, spinal accessory, sympathetic, loop between two first cervical nerves.*

Descends behind & between int. & comm. carotid arteries & int. jugular v. and in same sheath;
Then,

ON RIGHT SIDE:
Between subclavian art. & v. and along side of trachea to back of root of lung, where spreads out into posterior pulmonary plexus.
Along side of œsophagus in the shape of two or more separate cords, which form œsophageal plexus with nerve of opposite side.
As a single cord along back of œsophagus to posterior surface of stomach, and joins solar & splenic plexuses.

ON LEFT SIDE:
Between and in front of left comm. carotid & left subclavian arteries behind left innominate vein.
Across arch of aorta to back of root of lung, where similarly spreads out and joins with its fellow.
Along side of œsophagus as above.
As a single cord along front of œsophagus to anterior surface of stomach, and joins left hepatic plexus.

BRANCHES:

Auricular Br. — Arises from g. of the root, and joins with glosso-pharyngeal.
Across jugular fossa & through opening in temporal bone near styloid process;
Between mastoid process & ext. audit. meatus to integument of back of pinna.
Gives off:
ASCENDING BR., which joins trunk of facial in aqueductus Fallopii;
DESCENDING BR., which joins auricular branch of facial.

Pharyngeal Br. — Arises from upper part of ganglion of the trunk;
Crosses internal carotid art. either in front or behind;
Anast. with glosso-pharyngeal, sup. laryngeal & sympathetic, and forms pharyngeal plexus to muscles & mucous membrane of pharynx.

Sup. Laryngeal N. — Arises from middle of ganglion of the trunk.
Descends by side of pharynx behind int. carotid artery, and divides into:
EXT. LARYNGEAL BR. — Joins with pharyngeal plexus & sup. cardiac nerve, and supplies crico-thyroid & inf. constrictor.
INT. LARYNGEAL BR. — Pierces thyro-hyoid membrane to arytenoid muscle and mucous membrane of larynx, base of tongue & aryteno-epiglottidean folds.

Recurr. Laryngeal N. — Ar. in front of, and passes below & behind, subclav. art. on right side, arch of aorta, on left, giving twigs to deep cardiac plexus;
Behind comm. carotid & inf. thyroid arteries, and in groove between trachea & œsophagus.
Beneath inf. constrictor to all the muscles of the larynx except crico-thyroid.
Gives brs. to inf. constrictor, and anastomoses with ext. laryngeal.

Cardiac Brs. — Divided into:
CERVICAL CARDIAC, THORACIC CARDIAC } Vide Nerves of the Heart.

Pulmonary Brs. — Divided into ANTERIOR and POSTERIOR, and form the ant. & post. pulmonary plexuses. (Vide nerves of the lung.)

Œsophageal Brs. — Arise, some above, but most of them below, the pulmonary.

Gastric Brs. — Right pneumogastric supplies post. aspect of stomach and joins solar & splenic plexuses; left pneumog. supplies ant. aspect, and joins left hepatic plexus.

HYPOGLOSSAL NERVE.

Arises by ten or twelve filaments from *groove between anterior pyramid & olivary body* in a li
continuous with that of the anterior roots of the spinal nerves. These filamen
form two bundles which perforate dura mater separately, and pass together throu
anterior condyloid foramen.

Fig (Brit) pag 167

Passes downwards and forwards between pneumogastric & spinal accessory ns., with former
which it is intimately connected, and between int. jugular vein & int. caroti

Fig 407 pag 194

Loops round occipital artery and passes forwards across external carotid below post. belly
digastri

Passes beneath posterior belly of digastric & stylo-hyoid and crosses hyo-glossus, near a
border of which it anastomoses with gustato

Passes beneath mylo-hyoid to muscles & substance of the tongue.

BRS. OF COMMUNICATION — Join with:

G. of the trunk of the pneumogastric;
Sup. cervical g. of the sympathetic;
Loop between the two first cervical ns.
} Arise near base of skull.

Gustatory n. — Arises near ant. border of hyo-glossus.

BRS. OF DISTRIBUTION — Are the:

Descendens - Hypo-
glossal is branch of
1st & 2nd Cervical
nerves (sometimes 3rd)
Fig 374
Muscular br. from Hypoglossal - descendens -
hypoglossal gives right to
the plexus - left to
sternum plexus)

Descendens Noni — Long & slender. Arises just beneath occipital artery.
Passes downwards & forwards across sheath of carotid vessels. (Sometim
within the sheath, either over or beneath int. jugular vein
Near middle of neck forms a loop with Communicans Noni, from convexi
of which loop, brs. are given off to sterno-hyoid & -thyroid a
omo-hyo

This br. is believed to derive its real origin principally from the 1
& 3rd cervical ns., and to have little more than an appare
origin from the hypoglossal, due to a temporary adhesion
its fibres to those of that nerve. Sometimes, owing to simil
adhesions, it appears to arise from the pneumogastric eith
wholly or in pa

Brs. to Thyro-hyoid & Genio-hyoid — Arise on surface of hyo-glossus.

**Brs. to Stylo-glossus, Hyo-glossus, Genio-hyo-glossus & sub
tance of the tongue.** — Arise beneath milo-hyo

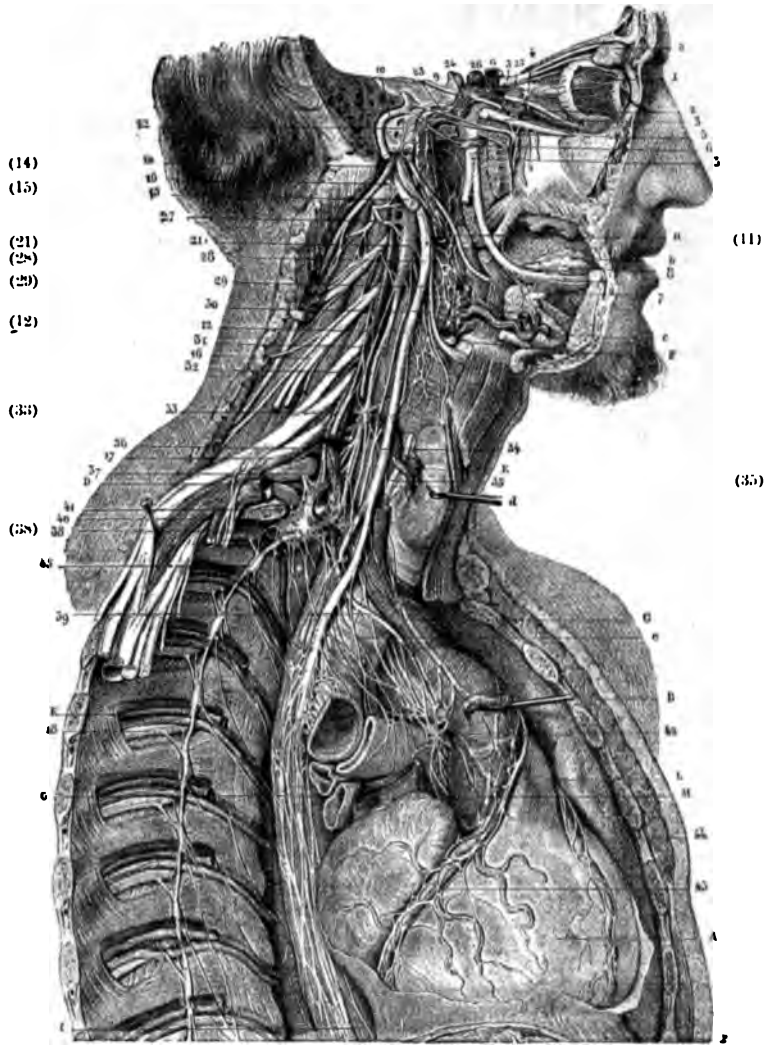


FIG. 376. DISTRIBUTION OF THE RIGHT PNEUMOGASTRIC & SYMPATHETIC NERVES. (Hirschfeld.)

12, pneumogastric nerve, with its inferior ganglion, or ganglion of the trunk, 28;
15, central end of the divided hypoglossal nerve;
29, superior laryngeal nerve;
35, inferior or recurrent laryngeal nerve passing behind the inferior thyroid artery and reaching the larynx beneath the inferior constrictor; it is seen lower down winding round the subclavian artery;
14, spinal accessory nerve;
11, glosso-pharyngeal nerve;
21, 33, 38, superior, middle, and interior cervical ganglia of the sympathetic, with their communications.

(See expl., p. 256w.)

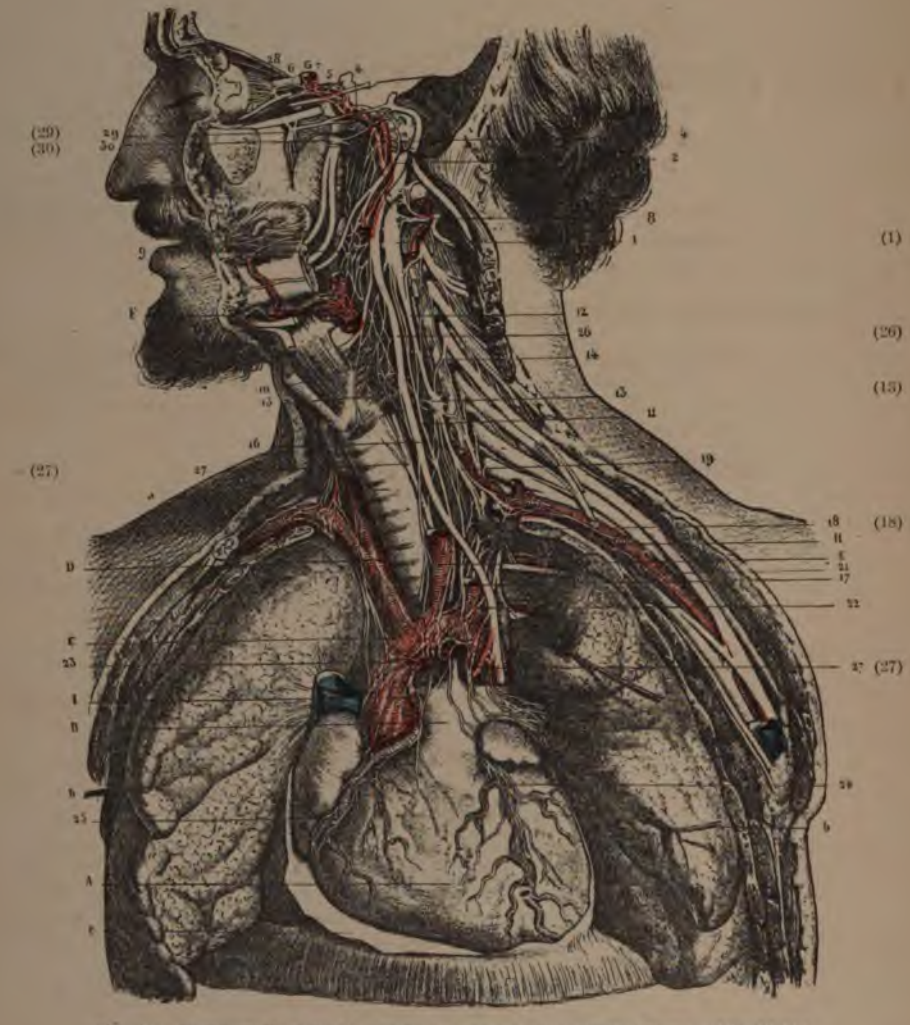


FIG. 377.—DISTRIBUTION OF THE LEFT PNEUMOGASTRIC & SYMPATHETIC NERVES. (Hirschfeld.)

(26, 27, 27) Pneumogastric and recurrent laryngeal nerves;

(1, 13, 18) The three cervical ganglia of the sympathetic;

12, 19, the cord of the sympathetic joining them;

8, connections between the superior cervical ganglion and the upper cervical nerves;

2, the ascending branch of the superior cervical ganglion passing up on the internal carotid artery to form the carotid & cavernous plexuses.

F, the external carotid artery with the sympathetic filaments upon it;

11, 17, 22, the three cardiac nerves;

10, pharyngeal plexus;

(28, 29, 30) Lenticular, spheno-palatine, and otic ganglia.

(See expl., p. 256w.)

CERVICAL PORTION of the SYMPATHETIC.

Consists on each side of three ganglia, the superior, middle & inferior cervical (of which the middle one is sometimes wanting), and of their respective branches of communication & distribution.

THE THREE GANGLIA:

Superior Cervical Ganglion - The *largest,* usually fusiform in shape and situated between the rectus capitis anticus major & the internal carotid *opposite the 2nd & 3rd cervical vertebræ;* sometimes irregular in shape & situated a little lower than usual.

Middle Cervical Ganglion - When present, is the *smallest* of the three and is situated *opposite the 5th cervical vertebra* in the vicinity of the inferior thyroid artery.

Inferior Cervical Ganglion - *Intermediate in size* between the two others, and situated *between the neck of the first rib & the transverse process of the last cervical vertebra* on inner side of superior intercostal artery; is irregular in form, and is frequently joined with the first thoracic ganglion.

THEIR COMMUNICATIONS:

These ganglia communicate *with each other* through the main cord of the sympathetic and with the cerebro-spinal nerves as follows:

SUPERIOR CERVICAL GANGLION — With:
- *Petrosal Ganglion of the Glosso-pharyngeal;*
- *Both Ganglia of the Pneumogastric;*
- *Trunk of the Hypoglossal;*
- *Four upper Cervical Nerves* - (Sometimes with the two upper nerves only, the branches of communication with the 3rd & 4th nerves occasionally joining the cord of the sympathetic a little below the ganglion).

MIDDLE CERVICAL GANGLION — With:
- *Fifth & Sixth Cervical Nerves* - (In case of absence of the middle cervical ganglion the 5th & 6th cervical nerves join with the cord of the sympathetic between the superior & inferior ganglia.

INFERIOR CERVICAL GANGLION -- With:
- *Seventh & Eighth Cervical Nerves.*

THEIR BRANCHES OF DISTRIBUTION — Vide next Tablet.

BRS. of DISTRIB. of the CERV. G. of the SYMPATHETIC.

These ganglia give off branches to the neighbouring arteries and to the viscera as follows:

BRS. to the NEIGHBOURING ARTERIES:

SUP. CERVICAL GANGLION — Gives off:

ASCENDING BRANCH TO INTERNAL CAROTID ARTERY & ITS BRANCHES — Large, soft, of a reddish grey colour, and appears to be the direct continuation of the ganglion. It passes along the posterior aspect of internal carotid artery and divides on reaching the carotid canal into internal & external branches.

INTERNAL BRANCH – The smaller; ascends on inner side of internal carotid artery, communicating with the outer branch, and goes to form the greater part of the cavernous plexus.

EXTERNAL BRANCH – The larger; ascends on outer side of internal carotid artery, communicating with the inner branch, and goes to form the greater part of the carotid plexus.

ANTERIOR BRANCHES TO EXTERNAL CAROTID ARTERY & ITS BRANCHES — Form *delicate plexuses which accompany the external carotid artery & its branches*, and on the filaments of which small ganglia are sometimes found. - From the plexus on the trunk of the external carotid artery a communicating branch is given off to the digastric branch of the facial nerve; from the plexus on the facial artery is derived the sympathetic root of the submaxillary ganglion; from the plexus on the internal maxillary artery is derived the sympathetic root of the otic ganglion and also a twig to the intumescentia gangliformis of the facial.

MIDDLE CERVICAL GANGLION — Gives off:

THYROID BRANCHES — Accompany the inferior thyroid artery, communicating with superior cardiac nerve, and reach the thyroid body, in which they communicate with the recurrent & external laryngeal nerves.

INF. CERVICAL GANGLION — Gives off:

BRANCHES TO VERTEBRAL ARTERY — Form a plexus round that vessel, and communicate with the cervical nerves as high as the 4th.

BRS. to the VISCERA — Are the:

Cardiac Nerves – Vide Next Tablet.

Pharyngeal Branches of the Superior Cervical Ganglion – Join with the pharyngeal branches of the *glosso-pharyngeal, pneumogastric, & external laryngeal* to form the pharyngeal plexus, which plexus supplies the muscles & the mucous membrane of the pharynx.

Thyroid Branches of the Middle Cervical Ganglion – Vide above.

HEAD & NECK.

III.

THE FACE.

Galea - occipito - aponeurosis & M. frontalis muscle
Calvarium - Skull-cap.

MUSCLES of the FACE—1st Tablet.

Are the:

OCCIPITO-FRONTALIS.

Frontal Portion – Innermost fibres are continuous with pyramidalis nasi, the others blend with orbicularis palpebrarum & corrugator supercilii.

Occipital Portion – Outer two-thirds of superior curved line of occipital bone, and mastoid portion of temporal.

The intervening epicranial aponeurosis is attached behind, between the two occipital portions, to the external occipital protuberance & to the superior curved lines; laterally it gives attachment to the attrahens & attollens aurem, and, becoming considerably thinned, passes over the temporal fascia to the zygoma. – It is intimately connected to the integument, loosely to the pericranium.

S., frontal portion by facial nerve, occipital portion by small occipital branch of cervical plexus & by auricular branch of facial.

MUSCLES of the EAR.

Attollens Aurem, or Auricularis Superior – Temporal portion of epicranial aponeurosis.

Upper and anterior part of helix & upper part of concha. – S. by small occipital branch of cervical plexus.

Attrahens Aurem, or Auricularis Anterior – Lateral prolongation of epicranial aponeurosis below & in front of preceding.

Front part of helix. – S. by facial nerve.

Retrahens Aurem, or Auricularis Posterior – Mastoid process.

Back of concha – S. by auricular branch of facial.

MUSCLES of the NOSE.

MUSCLES of the EYELIDS & ORBIT.

MUSCLES of the MOUTH.

ELEVATOR MUSCLES of the LOWER JAW — Vide following Tablets.

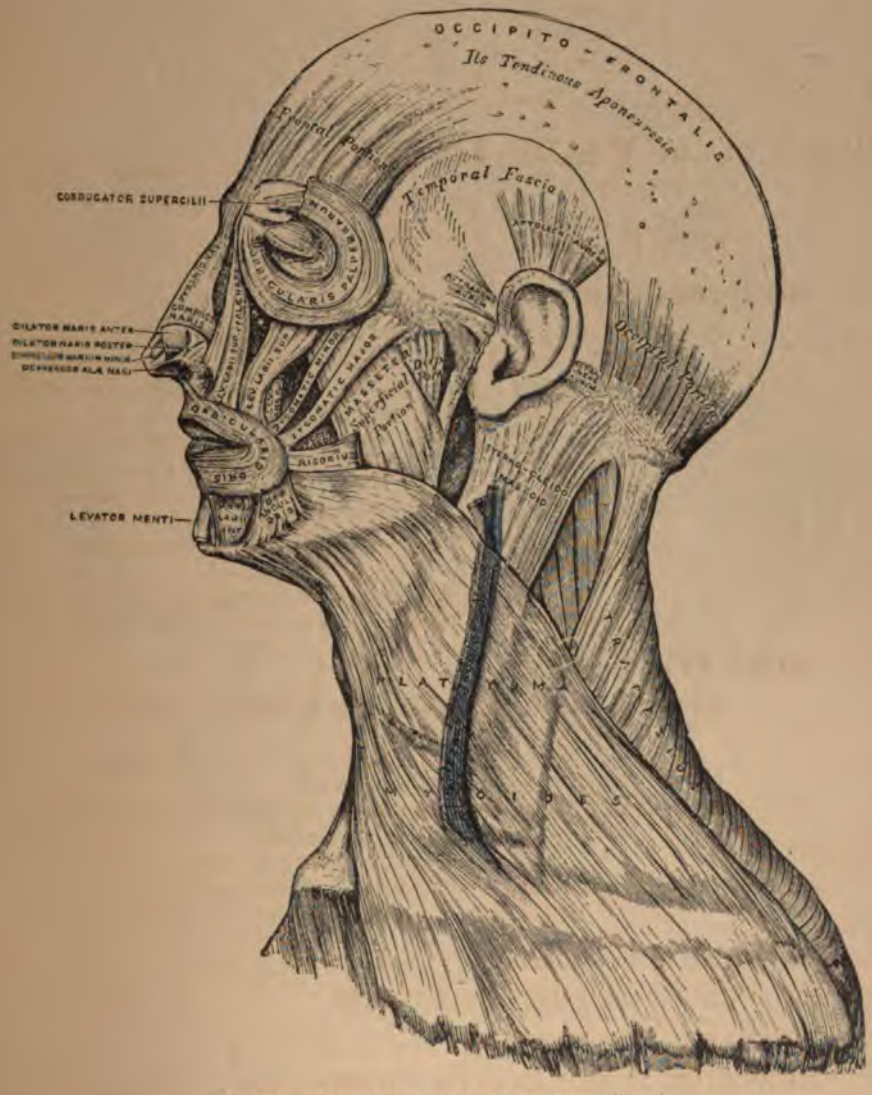


Fig. 378.—The muscles of the face, side view. (Gray.)

FIG. 379.—MUSCLES OF THE FACE. (Cloquet.)

MUSCLES of the FACE—2nd Tablet.

MUSCLES OF THE NOSE.

Pyramidalis Nasi – Continuous superiorly with innermost fibres of occipito-frontalis.
Aponeurosis of compressor nasi.

Compressor Nasi – Lower & inner part of canine fosa.
Aponeurosis continuous with that of its fellow over bridge of nose.

Levator Labii Superioris Alæque Nasi – Upper part of nasal process of superior maxilla.
Cartilage of ala of nose and upper lip blending with orbicularis & levator labii superioris proprius.

Depressor Alæ Nasi – Myrtiform fossa or incisor fossa of upper jaw.
Septum and back part of ala of nose.

Irregular and indistinct fasciculi may be found over the alar cartilages forming the:
LEVATOR PROPRIUS ALÆ NASI POSTERIOR OR DILATATOR NARIS POSTERIOR,
LEVATOR PROPRIUS ALÆ NASI ANTERIOR OR DILATATOR NARIS ANTERIOR,
COMPRESSOR NARIUM MINOR.

MUSCLES OF THE EYELIDS.

Orbicularis Palpebrarum – Anterior surface and edges of tendo oculi, internal angular process of frontal, nasal process of superior maxilla in front of lachrymal groove.

ORBICULAR PORTION – Thick & red, forms complete ellipses, and blends superiorly with occipito-frontalis and corrugator supercilii.

PALPEBRAL OR CILIARY PORTION – Thin & pale, forms a series of concentric curves, and is inserted externally into external tarsal ligament & malar bone.

TENDO OCULI OR TENDO PALPEBRARUM – From nasal process of superior maxilla in front of lachrymal groove. Crosses anterior aspect of lachrymal sac, giving off a fibrous lamina, the reflected portion of the tendo oculi, which passes backwards & inwards behind lachrymal sac to be attached to ridge on lachrymal bone. Bifurcates and is attached to inner extremity of each tarsal cartilage.

Corrugator Supercilii – Inner extremity of superciliary ridge of frontal.
Under surface of orbicularis & occipito-frontalis.

Tensor Tarsi – Ridge & posterior part of outer surface of lachrymal bone.
Crosses posterior aspect of lachrymal sac, and divides into two slips which are inserted into tarsal cartilages near puncta lachrymalia. – May be considered as a deep part of ciliary portion of orbicularis.

Levator Palpebræ Superioris – Under surface of lesser wing of sphenoid in front of optic foramen and externally to superior oblique.
Upper border of tarsal cartilage.

MUSCLES of the FACE—3rd Tablet.

MUSCLES of the MOUTH.

Orbicularis Oris – Consists of three portions:

LABIAL OR MARGINAL PORTION – Continued uninterruptedly from one lip to the other round the commissures of the mouth.

FACIAL PORTION – Central fibres decussate with, the others are directly continuous with, fibres of buccinator.

ACCESSORY PORTION – Consists for the upper lip of four fasciculi, the musculi accessorii orbicularis superiores, arising from superior maxilla opposite incisor teeth & from septum of the nose; and for lower lip, of two fasciculi, the musculi accessorii orbicularis inferiores, from inferior maxilla near the canine teeth.

Inserted into this muscle and into the integument covering it from the middle of the upper lip to the middle of the lower lip, are the following muscles (the last excepted), which all blend more or less with each other:–

Levator Labii Superioris Alæque Nasi – Upper part of nasal process of superior maxilla.

Levator Proprius Labii Superioris – Superior maxillary & malar bones close to margin of orbit.

Levator Anguli Oris or Musculus Caninus – Canine fossa just below infra-orbital foramen.

Zygomaticus Minor – Lower and front part of malar bone.

Zygomaticus Major – Malar bone near zygomatic suture.

Buccinator – Outer surface of alveolar processes of superior & inferior maxillæ corresponding to the molar teeth, and from pterygo-maxillary ligament (which latter is a fibrous band extending from apex of internal pterygoid plate to posterior extremity of mylo-hyoid ridge of lower jaw, and which gives attachment posteriorly to superior constrictor of pharynx).

Its fibres are continuous with those of facial portion of orbicularis oris, the middle ones decussating, the superior & inferior ones passing directly into corresponding lip.

Risorius – Fascia over parotid gland & masseter. – Is often described as the upper part of platysma myoides.

Depressor Anguli Oris or Triangularis Oris – External oblique line of lower jaw externally to mental foramen.

Depressor Labii Inferioris or Quadratus Menti – External oblique line of lower jaw between symphysis & mental foramen.

Levator Labii Inferioris or Levator Menti – Incisor fossa of lower jaw.

Integument of chin close to median line.

FACIAL ARTERY.

Arises above lingual beneath thin anterior margin of sterno-mastoid.
Forwards & upwards beneath posterior belly of digastric & stylo-hyoid & submaxillary gld.
Crosses jaw bone in front of masseter.
Forwards and upwards to angle of mouth upon buccinator & beneath platysma.
Upwards beneath zygomatici and upon levator anguli oris and the levators of the lip & ala of the nose to inner canthus, where becomes angular artery and joins with ophthalmic.
Is very tortuous in its course. Facial vein lies behind it, and is less tortuous. Gives off branches:

Inferior or Ascending Palatine – Dips beneath ramus of jaw. Ascends between stylo-glossus & -pharyngeus and then upon superior constrictor in front of ascending pharyngeal, and supplies tonsil & soft palate.

Tonsillar – Ascends upon and perforates sup. constrictor to tonsil & root of tongue.

Submaxillary – Three or four, to submaxillary gland & surrounding muscles.

Submental – Forwards on under surface of mylo-hyoid, and between it and digastric to symphysis, where ascends upon chin.

Inf. Labial – Forwards beneath depressor anguli oris, below following artery to tissues of lower lip.

Inf. Coronary – Forwards beneath depressor anguli oris, and tortuous course through substance of orbicularis and between it & mucous membrane, anastomosing with its fellow.

Sup. Coronary – Larger and more tortuous; similar course along free edge of upper lip, giving twigs to ala and artery of septum to septum of nose.

Lateralis Nasi – To ala and dorsum of nose.

Angular – To inner canthus, supplying lachrymal sac and anastomosing with nasal branch of ophthalmic.

All these branches anastomose freely with each other, with those of the opposite side, and with the mental, transverse facial, infra-orbital, ophthalmic, sublingual, posterior superior or descending palatine and ascending pharyngeal arteries.

TEMPORAL ARTERY.

Commences in substance of parotid gland between neck of condyle & external auditor meatu

Ascends in groove between condyle & external auditory meatus, and crosses posteric root of zygom

Ascends for about two inches upon temporal muscle & fascia, and beneath skin & attri hens aurem, with branches of facial & auriculo-temporal nerves, and divides int

Ant. Temporal – The smaller. Forwards over forehead, and joi with supraorbital & fronta

Post. Temporal – The larger. Upwards & backwards, and joins wit posterior auricular & occipita

Gives off before its division:

Twigs – To parotid gland & temporo-maxillary articulation.

Transverse Facial – Forwards through parotid gland, and across face b tween Steno's duct & zygoma; joins with facial & infraorbita

Middle Temporal – Through temporal fascia to temporal muscle, joinin with deep temporal branches of internal maxillary. Often gives o

ORBITAL BRANCH – To outer angle of orbit along upper border of zygoma between the two layers of temporal fasci

Ant. Auricular – Two or three small branches to external ear.

Fig. 380.—Superficial distribution of the facial, trigeminal, and other nerves of the head. (Sappey, Hirschfeld.) (See expl., p. 228k.)

Figs. 381 & 382.—Right facial nerve in temporal bone (Sappey, Hirschfeld), seen:

From above. 1, facial nerve; 2, its geniculate ganglion; 3, large superficial petrosal nerve; 5, auditory nerve.

From the side. 1, 2, 3, 4, facial nerve; 5, its geniculate ganglion; 6, large superficial petrosal nerve; 7, Meckel's ganglion; 9, chorda tympani.

(See explanation of these figures on pp. 228k & 228l.)

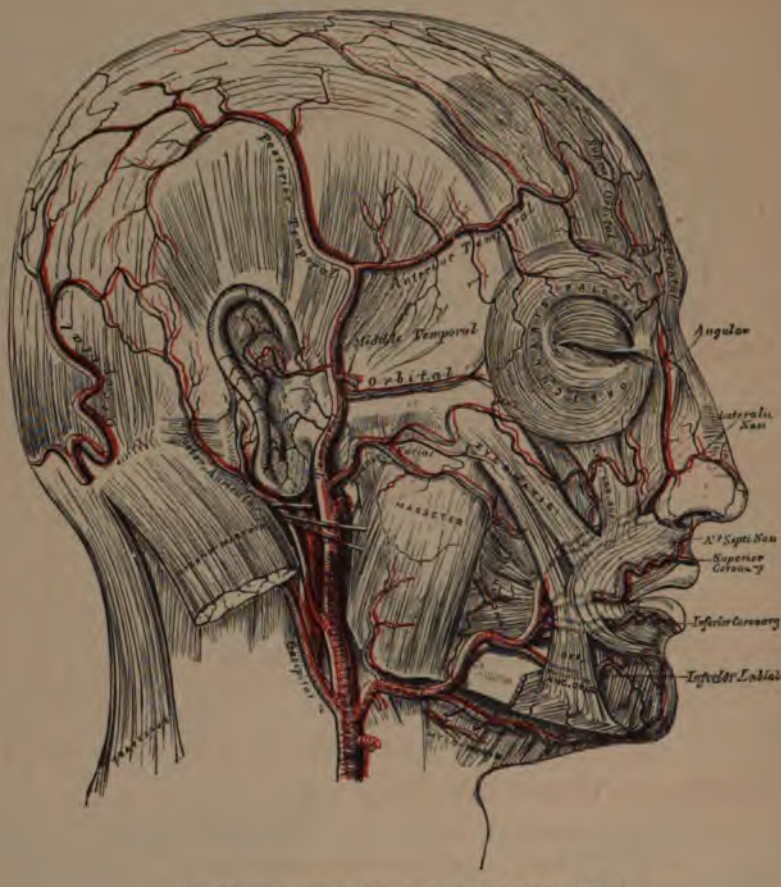


Fig. 383.—The arteries of the face and scalp. (Gray.)

Fig. 384.—The communications of the right facial nerve with Jacobson's nerve and Meckel's and the otic ganglia. (Hirschfeld.)

1, 5, 6, right facial nerve; 2, geniculate ganglion; 3, large superficial petrosal nerve, going to Meckel's ganglion, 4; 15, small superficial petrosal nerve, going to the otic ganglion, 16; 8, chorda tympani, divided. (See expl., p. 228k; see also Fig. 382, p. 178a.)

FACIAL NERVE.

Arises from upper part of medulla oblongata in groove between olivary & restiform bodies.

Through internal auditory meatus with portio mollis, lying in a groove upon the latter and portio intermedia of Wrisberg lying between the two.

Through aqueductus Fallopii, in which runs outwards, backwards, downwards:

Outwards – between cochlea and vestibule to hiatus Fallopii, where presents geniculate ganglion or intumescentia gangliformis.

Backwards – in inner wall of tympanum above fenestra ovalis.

Downwards – to stylo-mastoid foramen.

Forwards in substance of parotid gland crossing external carotid artery, and divides behind ramus of jaw into temporo-facial & cervico-facial branches, forming pes anserinus.

Its branches may be divided into branches of communication & branches of distribution.

BRANCHES OF COMMUNICATION — Are:

In Meatus Auditorius Internus:

One or two filaments to AUDITORY N.

In Aqueductus Falloppii:

LARGE PETROSAL N. – to Meckel's ganglion, and supplies *levator palati & azygos uvulæ*;
SMALL PETROSAL N. – to Otic ganglion, and supplies *tensor palati & tensor tympani*;
EXT. PETROSAL N. – to sympathetic on middle meningeal artery.

After Exit from Stylo-mastoid Foramen:

Branches to: GLOSSO-PHARYNGEAL, PNEUMOGASTRIC & CAROTID PLEXUS – Arise from posterior auricular nerve & from nerves to stylo-hyoid & posterior belly of digastric.

1° AURICULO-TEMPORAL – From temporo-facial branch.
1c GREAT AURICULAR – From posterior auricular & cervico-facial branches.

On the Face:

The terminal filaments join with the three divisions of the FIFTH N.

BRANCHES OF DISTRIBUTION — Are:

In Aqueductus Fallopii:

TYMPANIC BR. – To *stapedius & laxator tympani*;
CHORDA TYMPANI – Enters tymp. between membr. tympani & base of pyramid;
Between handle of malleus & long process of incus.
Through canal of Huguier on inner side of Glaserian fissure;
Joins gustatory nerve between the two pterygoid muscles;
To submaxillary ganglion & lingualis superior.

After Exit from Stylo-mastoid Foramen:

POST. AURICULAR N. – Over mastoid process to integument and retrahens aurem & posterior belly of occipito-frontalis, and anastomoses with auricularis magnus & posterior auricular branch of pneumogastric.

BRS. TO STYLO-HYOID & POST. BELLY OF DIGASTRIC – Arise in common, and join, the former with carotid plexus, the latter with glosso-pharyngeal.

On the Face:

TEMPORO-FACIAL BR. – The larger. Anastomoses with auriculo-temporal, and divides into *temporal, malar & infraorbital branches.*

CERVICO-FACIAL – The smaller. Anastomoses with great auricular, and divides into *buccal, supramaxillary & inframaxillary branche.*

These terminal branches of the facial nerve supply all the muscles of expression of the face & the platysma, and anastomose with the ophthalmic, superior & inferior maxillary nerves and with the great auricular.

THE SALIVARY GLANDS—1st Tablet.

Are the parotid, submaxillary & sublingual, and numerous smaller glands situated beneath the mucous membrane of the mouth. They are all conglomerate or racemose glands.

PAROTID GLAND

Lies below & in front of external ear, and stretches forwards to a variable extent on outer surface of masseter, often presenting in that situation and just below zygoma, a small detached portion, the socia parotidis.

Is bounded by:

ABOVE – Zygoma.

BELOW – Line drawn from angle of jaw to sterno-mastoid.

BEHIND – External auditory meatus, mastoid process, sterno-mastoid, posterior belly of digastric.

Presents:

OUTER SURFACE – Lobulated. Covered by integument, fascia & a few fibres of platysma.

INNER SURFACE – Prolonged deeply in front of and behind styloid process towards internal carotid & internal jugular vein, wall of pharynx & deep part of glenoid fossa.

ANT. SURFACE – Grooved externally for posterior border of ramus, and prolonged forwards, internally, between the two pterygoid muscles.

POST. SURFACE – Rests upon external auditory meatus, mastoid process, sterno-mastoid, posterior belly of digastric.

Is perforated by several

ARTERIES – *External carotid* with its *posterior auricular*, *internal maxillary* & *temporal* branches, and the *transverse facial* offset of the latter.

VEINS – *Internal maxillary* & *temporal* forming origin of *external jugular*, and a *branch of communication* between the latter & the internal jugular.

NERVES – *Facial*, *auriculo-temporal* & deep facial branches of *great auricular*.

ITS VESSELS & NERVES are – ARTERIES & VEINS, from or to above mentioned trunks. – LYMPHATICS, to two or three lymphatic glands in substance & on surface of parotid, and from thence to superficial & deep glands of neck. – NERVES, from carotid plexus, auriculo-temporal & great auricular.

PAROTID DUCT (Steno's or Stenson's) — From anterior border of the gland and from socia parotidis when it exists. Over masseter a finger's breadth below zygoma, its direction being marked by a line from lower part of concha to midway between free margin of the lip & ala of the nose. Through fat of cheek & buccinator, and obliquely beneath mucous membrane, which it perforates opposite 2nd molar tooth of upper jaw.

HEAD & NECK.

IV.

PTERYGO-MAXILLARY REGION.

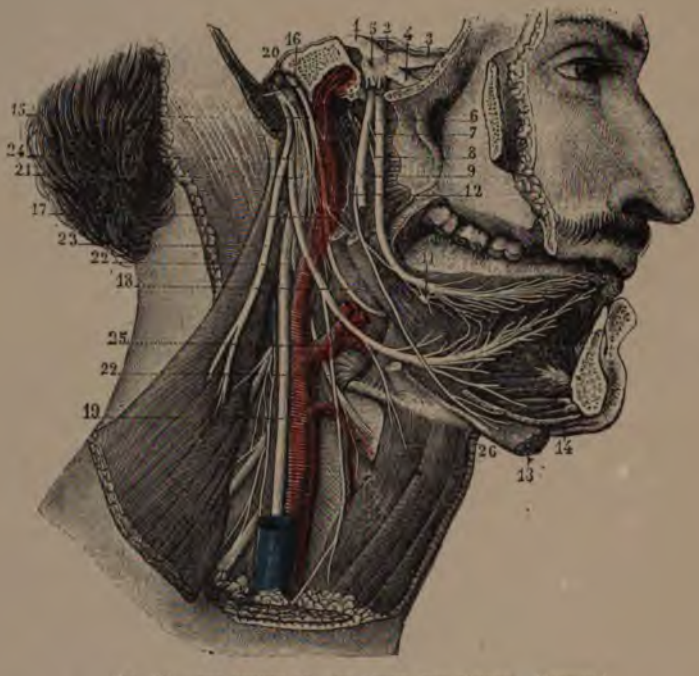


FIG. 391.—THE NERVES OF, AND ABOUT, THE TONGUE. (Sappey.)

1, sensory portion of the 5th nerve with the Gasserian ganglion; 2, and the ophthalmic and superior & inferior maxillary nerves, 3, 4, 5.

(6) **Gustatory nerve**; 7, its anastomosis with the inferior dental; 8, chorda tympani; 11, submaxillary ganglion.

(9) **Inferior dental nerve**, divided;

12, mylo-hyoid branch of inferior dental nerve supplying the anterior belly of the digastric, 13, and the mylo-hyoid (divided), 14.

(15, 18) **Glosso-pharyngeal nerve** with its petrosal ganglion, 16; and its branches to the stylo-glossus and stylo-pharyngeus, 17.

(19) **Pneumogastric nerve** with its superior & inferior ganglia, 20 & 21;

22, 22, superior laryngeal nerve.

(23) **Spinal accessory nerve.**

(24) **Hypoglossal nerve** with the descending hypoglossi, 25, and nerve to the thyro-hyoid, 26.

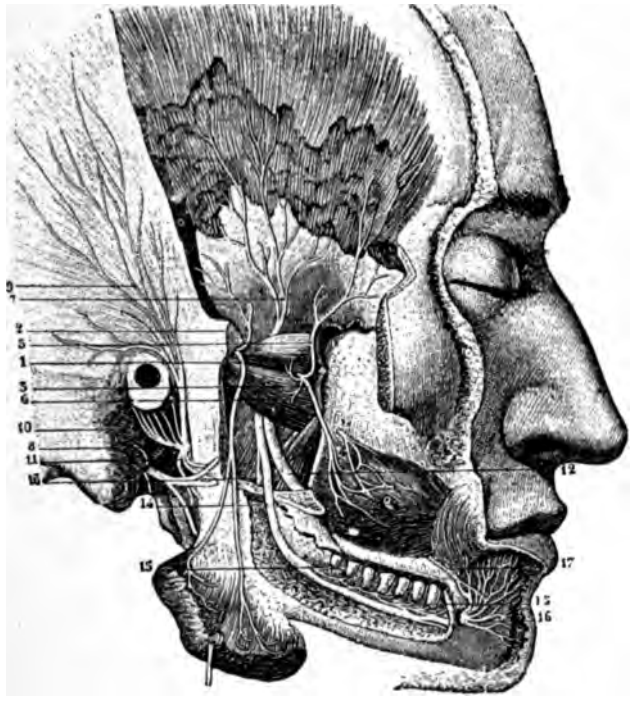


FIG. 392. - THE BRANCHES OF THE INFERIOR MAXILLARY NERVE. (Sappey, Hirschfeld.)

(1) Masseteric nerve.
(2) Posterior deep temporal nerve.
(3) Buccal nerve.
(5) Anterior deep temporal nerve ;
6, filaments given by the buccal to the external pterygoid muscle ;
7, middle deep temporal nerve.
(8) Auriculo-temporal nerve ;
9, its temporal branches ;
10, its branches to the meatus and auricle ;
11, its union with the facial.
(12) Lingual nerve ;
13, mylo-hyoid nerve.
(14) Inferior dental nerve ;
15, its twigs to the teeth ;
16, mental branch ;
17, branch of the facial, uniting with the mental.

The zygoma and part of the ramus of the lower jaw have been removed ; the dental canal has been opened up ; the lower part of the temporal muscle has been taken away, and the masseter muscle turned down.

FIG. 393.—TEMPORO-MAXILLARY ARTICULATION, INTERNAL VIEW.

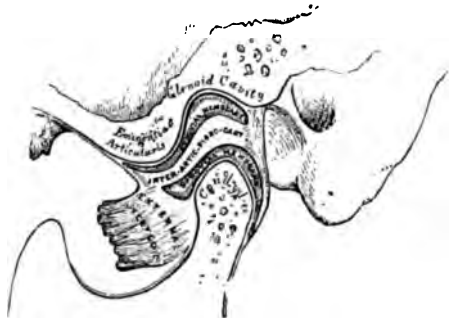


FIG. 394.—TEMPORO-MAXILLARY ARTICULATION, SAGITTAL SECTION.

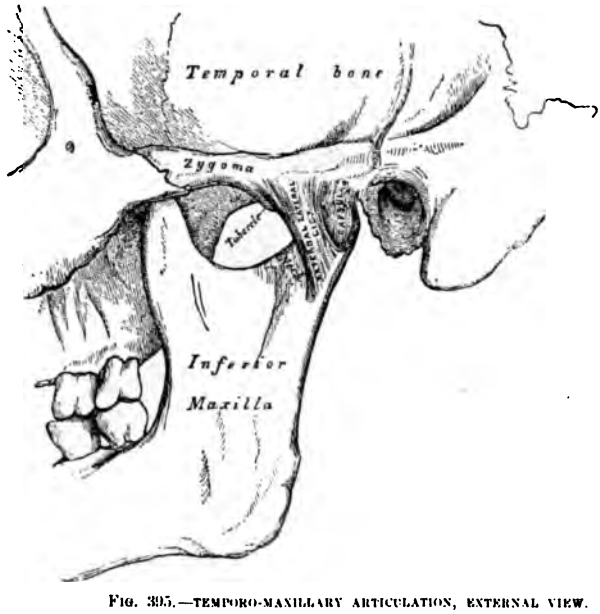


FIG. 395.—TEMPORO-MAXILLARY ARTICULATION, EXTERNAL VIEW.

Nerve supply of every joint is just the same as muscles
Vessels cross their joints
Sometimes additional nerves also

TEMPORO-MAXILLARY ARTICULATION.

Is a double or bilateral condyloid articulation (Cruveilhier) comprised between the condyles of the lower jaw, on the one hand, and the anterior root of the zygoma & anterior part of the glenoid cavity, on the other. The articulation is divided into two by an interarticular fibrocartilage, and presents two synovial membranes, of which the upper one is the largest & loosest. The interarticular fibrocartilage is thickest at the periphery, especially behind; its upper surface is concavo-convex from before backwards; its under surface is concave; its circumference is connected externally to the external lateral ligament, internally & in front to the tendon of the external pterygoid – Occasionally it is perforated in the centre, the two synovial membranes then communicating.

LIGAMENTS – Are:

Temporo-maxillary lig – Fibres, posterior & Capsular

Capsular – Thin & loose; from
Circumference of glenoid cavity & eminentia articularis to
Neck of Condyle

External Lateral – Broad band downwards & backwards from
Outer surface & tubercle of zygoma to
Outer surface & posterior border of neck of condyle.

2 **Internal Lateral** – Long & thin band from
Spine of sphenoid to
Inner margin of dental foramen. – It is related externally the to external pterygoid muscle, internal maxillary artery, and inferior dental vessels & nerve.

Stylo-Maxillary – Long thin band of somewhat secondary importance from
Apex of styloid process to
Angle & posterior border of ramus of jaw, where it spreads out considerably and marks the separation between parotid & submaxillary glands.

Pterygo-Maxillary (Part of deep fossa of neck)

MOVEMENTS – Are depression, elevation, projection, retraction, lateral displacement & circumduction. In slight movements of elevation & depression the condyles simply rotate on a transverse axis upon the interarticular fibrocartilages. In more extensive movements not only do the condyles rotate as above, but they also pass forwards with the interarticular fibrocartilages upon the eminentiæ articulares, the displacement being due to the laxity of the superior synovial membrane & to the action of the external lateral ligament. This displacement also takes place on the two sides alternately in the lateral or grinding movement of the jaw, and on both sides simultaneously in the projection of the jaw forwards.

INTERNAL MAXILLARY ARTERY.

Commences in substance of parotid gland behind neck of condyle.
May be divided into three portions:

FIRST or MAXILLARY PORTION — Forwards beneath tendon of external pterygoid, and between neck of condyle & internal lateral ligament of jaw, crossing inferior dental nerve.
Gives off **Tympanic, Middle meningeal, Small meningeal, Inferior dental.**

SECOND or PTERYGOID PORTION — Forwards & upwards on outer surface of external pterygoid, between it & temporal muscle.
Gives off **two Deep temporal, Masseteric, Pterygoid, & Buccal.**

THIRD or SPHENO-MAXILLARY PORTION — Into spheno-maxillary fossa between the two heads of external pterygoid.
Gives off **Alveolar, Infraorbital, Vidian, Pterygo-palatine, Sup. or descending palatine, Nasal or Spheno-palatine.**

Sometimes the artery passes behind, and along inner surface of, external pterygoid muscle, between it & internal pterygoid.

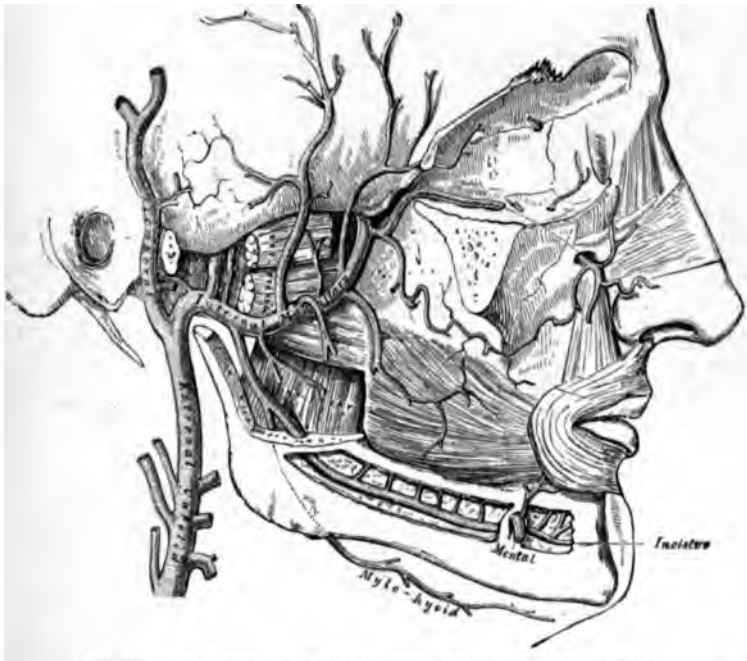


FIG. 396.—THE INTERNAL MAXILLARY ARTERY AND ITS BRANCHES. (Gray.)

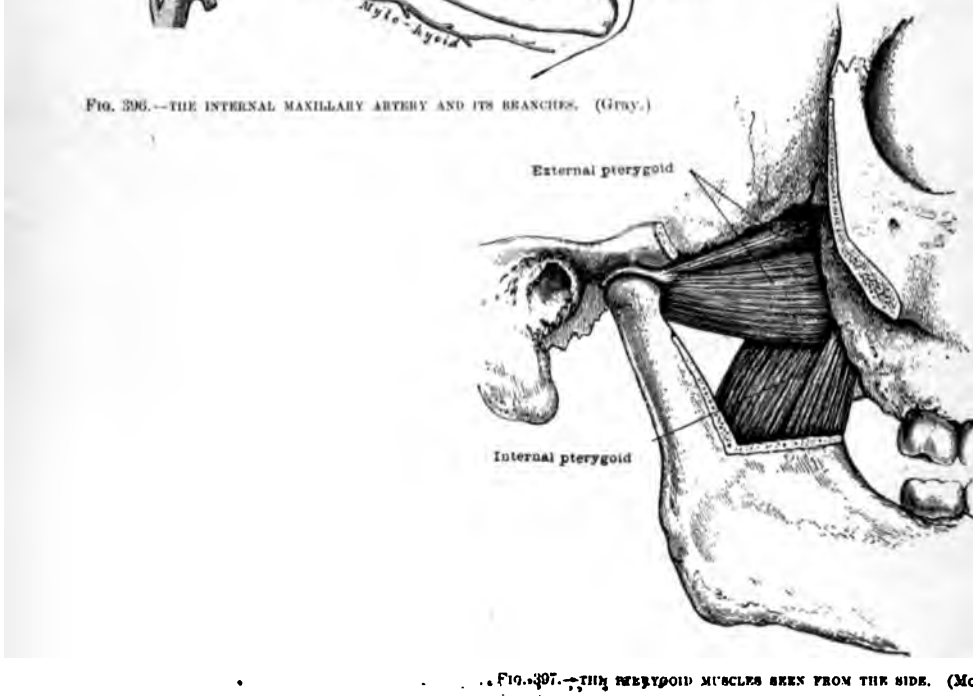


FIG. 397.—THE PTERYGOID MUSCLES SEEN FROM THE SIDE. (Morris.)

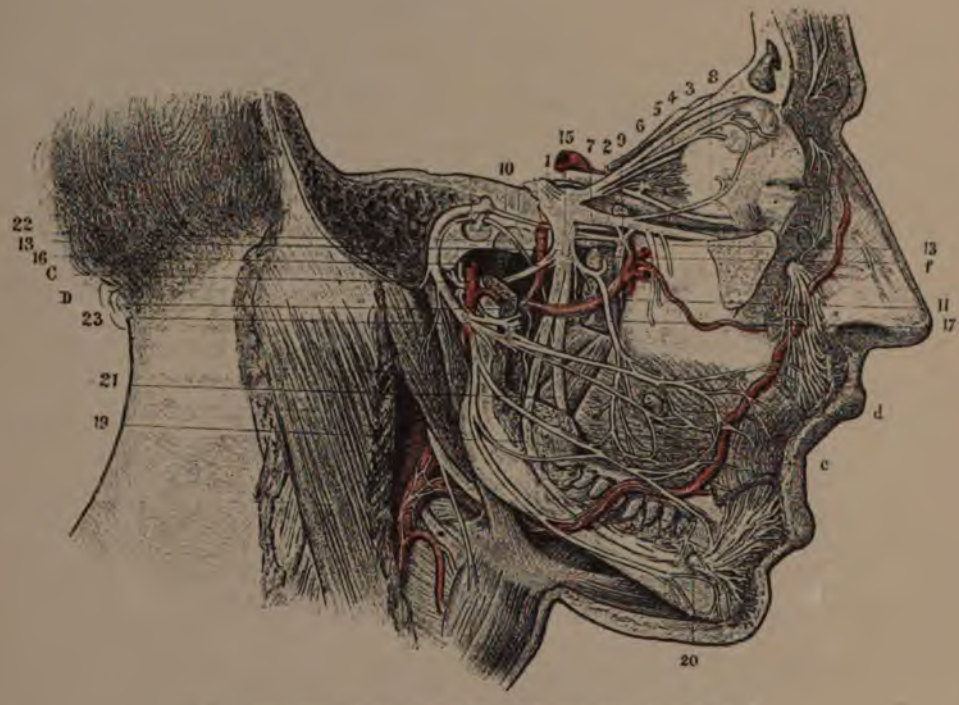


FIG. 398.—THE THREE BRANCHES OF THE FIFTH NERVE. (Hirschfeld.)

1, Gasserian ganglion.

(2) **Ophthalmic nerve.**

(3, 4, 5) **Its frontal, lachrymal, and nasal branches.**

(6) **Lenticular ganglion,** with its three roots and its ciliary offsets.

(7) **Superior maxillary nerve;**
8 & 13, its orbital or temporo-malar and its posterior dental branches

(9) **Meckel's ganglion,** hanging down from the superior maxillary nerve by the spheno-palatine branches of the latter;

10, large superficial petrosal branch of the facial, constituting its motor root, and joining with the sympathetic root a little before reaching the ganglion;

11, palatine nerves passing down from the ganglion, and entering the palatine canals.

(15) **The inferior maxillary nerve,** with, 18, its masseteric and deep temporal branches divided.

(16) **Auriculo-temporal nerve,** arising by two roots which embraced the middle meningeal artery. The nerve is seen winding round the neck of the condyle and the temporal artery, and anastomosing with the temporo-cervical branch of the facial;

17, buccal nerve.

(19) **Inferior dental nerve,** with its branches to the molar & bicuspid teeth, and its terminal or mental branch, 20.

(21) **Lingual or gustatory nerve,** receiving the chorda tympani from the facial, 22.

(23) **Facial nerve,** dividing into its two terminal branches, temporo- and cervico-facial, the latter anastomosing with the auriculo-temporal.

C, D, temporal & internal maxillary arteries;

F, middle meningeal in the partly opened foramen rotundum;

c, orbicularis oris, partly cut away;

d, Steno's duct, piercing the buccinator;

f, external pterygoid, divided.

(See Figure 418, p. 2263, for deeper dissection of the same part.)

BRANCHES of the INTERNAL MAXILLARY.

Tympanic – Through Glaserian fissure to tympanum, where joins with stylo-mastoid.

Middle or Great Meningeal – Through foramen spinosum, and divides into:
ANTERIOR BRANCH – Across great wing of sphenoid to groove or canal on anterior inferic angle of parietal, and divides into numerous branches to dura mater & skul
POSTERIOR BRANCH – Crosses squamous portion of temporal bone, and divides into simil branches. Gives twigs to facial nerve through hiatus Fallopii, which twi join with stylo-mastoi

Small Meningeal – Arises frequently from preceding; through foramen ovale to dura mater middle foss

Inferior Dental – With inferior dental nerve, similarly dividing opposite first bicuspid toot into *incisor & mental branches*, and likewise giving o
Mylo-hyoid branch – Along mylo-hyoid groove to mylo-hyoid muscle.

Deep Temporal – Two, anterior and posterior. Ascend between temporal muscle & pericraniun

Pterygoid – Vary in number and precise mode of origin.

Masseteric – Through sigmoid notch to masseter.

Buccal – Forwards upon buccinator to structures of cheek, joining with facial.

Alveolar – Descends upon tuberosity of superior maxilla, and divides into numerous branches molar teeth, gums & lining membrane of antrur

Infraorbital – Through infraorbital canal with superior maxillary nerve. Sends small twi into orbit, and others to front teeth through canals in anterior wall of antrur and divides beneath levator labii superioris int
Ascending branches – To inner angle of eye, where they join with nasal;
Descending branches – To upper lip; join with transverse facial, superior coronary bucca

Vidian – With vidian nerve through vidian canal to upper part of pharynx & Eustachian tub gives a twig to tympanur

Pterygo-Palatine – With pharyngeal or pterygo-palatine nerve through pterygo-palatine can to upper part of pharynx & Eustachian tub

Superior or Descending Palatine – Descends with anterior or great palatine nerve throug posterior palatine canal, sending twigs to soft palate. Forwards in groove o hard palate, giving twigs to mucous membrane & gums, and ascends throug incisor foramen to join artery of septur

Nasal or Spheno-Palatine – Through spheno-palatine foramen with superior nasal & nas palatine nerves, and divides int
INTERNAL BRANCH OR ARTERY OF SEPTUM – Downwards & forwards along septum, an joins with termination of descending palatin
EXTERNAL BRANCHES – Two or three to mucous membrane of outer wall of nose, and t ethmoidal & sphenoidal cells & Antrum

INFERIOR MAXILLARY NERVE.

The largest of the three divisions. Both sensory & motor, its two roots uniting immediately after their exit from foramen ovale.

Divides a few lines below base of skull into:

ANTERIOR or SMALLER DIVISION — Principally motor. Divides into:

Masseteric Br. – Outwards above external pterygoid muscle and through sigmoid notch to masseter. Gives off a twig to temporo-maxillary articulation & sometimes one to temporal muscle.

Deep Temporal Brs. – Two, anterior & posterior. Outwards above external pterygoid muscle and reflected upwards at pterygoid ridge to temporal muscle. Are sometimes joined, anterior one with buccal nerve, posterior one with masseteric.

Buccal Br. – Pierces external pterygoid, and forwards on buccinator, giving filaments to temporal muscle, integument & mucous membrane.

Pterygoid Brs. – Two, to internal & external pterygoid muscles. Branch to internal pterygoid gives off motor root to otic ganglion. Branch to external pterygoid is frequently derived from buccal.

POSTERIOR or LARGER DIVISION — Sensory with a few motor fibres. Divides into:

Auriculo-temporal N. – Has generally two roots which embrace middle meningeal artery. Backwards beneath external pterygoid & neck of condyle; Upwards with temporal artery between condyle & external ear under cover of parotid gland, and divides into:

AURICULAR BRS. – Inferior & superior, to outer surface of pinna, joining with great auricular.

TEMPORAL BRS. – Anterior & posterior; with branches of temporal artery to skin of temporal region & vertex.

Joins facial nerve behind neck of condyle usually by two branches; gives off sensory root of otic ganglion and filaments to parotid gland & temporo-maxillary articulation.

Gustatory or Lingual N. – Between the two pterygoid muscles, where it lies on inner side & in front of inferior dental nerve, and is joined by chorda tympani; Above deep portion of submaxillary gland & along side of tongue, crossing Wharton's duct.

Supplies mucous membrane of mouth & gums, submucous glands, conical & fungiform papillæ and mucous membrane of tongue.

Gives sensory branches to submaxillary ganglion, and anastomoses with hypoglossal nerve on anterior margin of hyo-glossus & near tip of tongue.

Inf. Dental N. – Between the two pterygoid muscles, where lies behind & on outer side of gustatory; Between ramus & internal lateral ligament of temporo-maxillary articulation to dental foramen, where gives off nerve to mylo-hyoid muscle.

Along inferior dental canal, giving branches to molar & bicuspid teeth, & divides at mental foramen into:

INCISOR BR. – Onwards in dental canal to canine & incisor teeth.

MENTAL BR. – Divides beneath depressor anguli oris into numerous branches to muscles, skin & mucous membrane of lower lip.

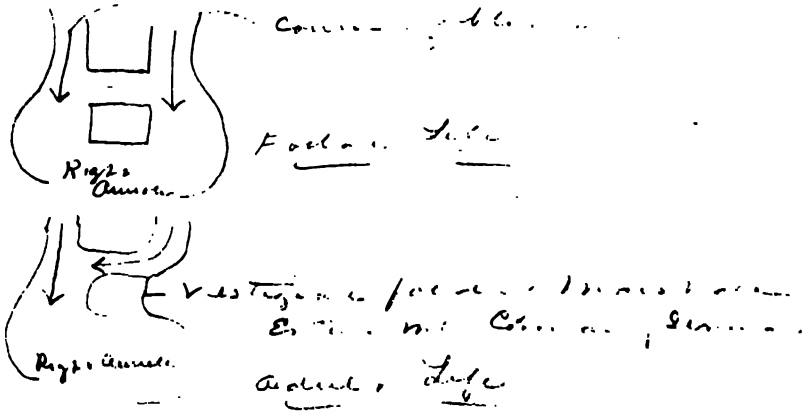
NERVE TO MYLO-HYOID – Along groove on inner surface of ramus to under surface of mylo-hyoid & anterior belly of digastric

N. — All the terminal branches of the 5th nerve upon the face. join with facial nerve.

HEAD & NECK.

V.

SUB-MAXILLARY REGION.



MUSCLES.

Digastric – Digastric groove on inner side of mastoid process. – Perforates stylo-hyoi and is held in connection with body & great cornu of hyoid bone by an apon eurotic loop lined with synovial membrane, from which loop it is reflecte upwards & forwards to

Rough depression on inner lip of lower border of jaw bone close to sym physis. – S., posterior belly by facial nerve, anterior belly by mylo-hyoid branch of inferior dental nerve.

Stylo-Hyoid – Middle of outer surface of styloid process.

Body of hyoid bone at its junction with great cornu. – S. by facial nerve

Mylo-Hyoid – Whole length of mylo-hyoid ridge.

Body of hyoid bone & median raphé from hyoid bone to symphysis. – S. mylo-hyoid branch of inferior dental nerve.

Genio-Hyoid – Inferior genial tubercle.

Anterior surface of body of hyoid bone. – S. by hypoglossal nerve.

FIG. 399.—THE SUBMAXILLARY TRIANGLE. (Ellis.)
(See expl., p. 2280.)

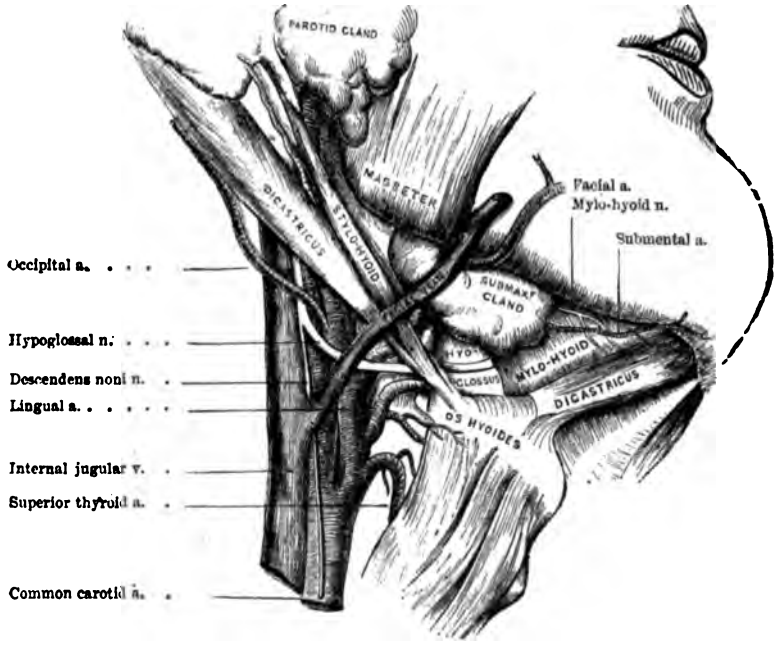


FIG. 400.—THE SUBMAXILLARY TRIANGLE. (Holden.)

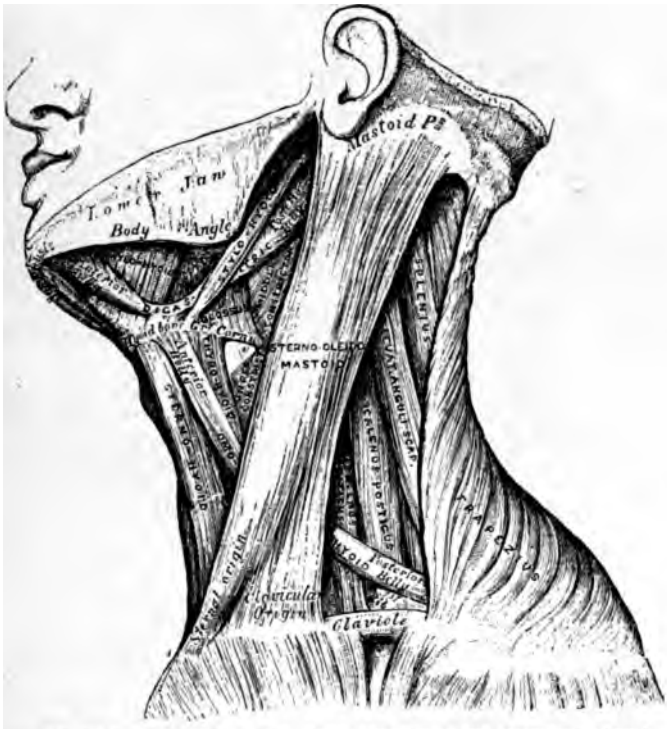


FIG. 401.—MUSCLES OF THE NECK, AND BOUNDARIES OF THE TRIANGLES. (Gray.)

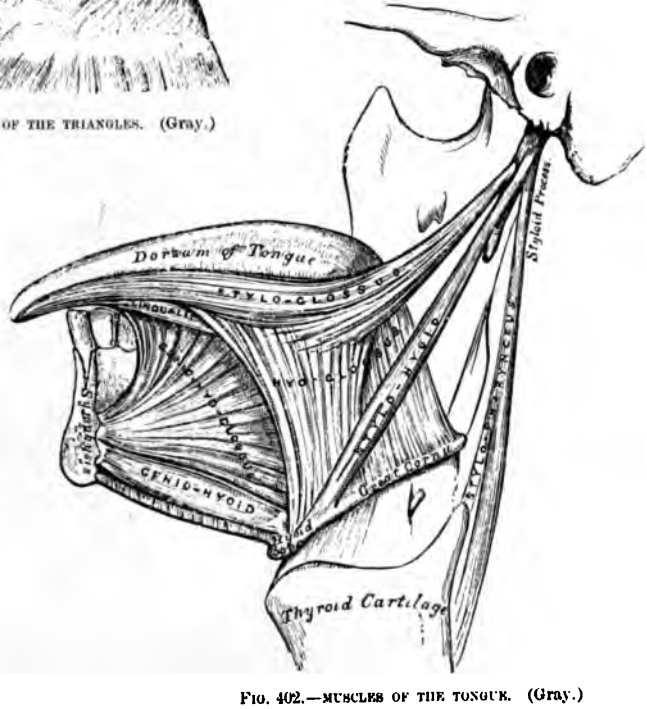


FIG. 402.—MUSCLES OF THE TONGUE. (Gray.)

FACIAL ARTERY.

Arises above lingual beneath thin anterior margin of sterno-mastoid.
Forwards & upwards beneath posterior belly of digastric & stylo-hyoid & submaxillary gld.
Crosses jaw bone in front of masseter.
Forwards and upwards to angle of mouth upon buccinator & beneath platysma.
Upwards beneath zygomatici and upon levator anguli oris and the levators of the lip & ala of the nose to inner canthus, where becomes angular artery and joins with ophthalmic.
Is very tortuous in its course. Facial vein lies behind it, and is less tortuous. Gives off branches:

Inferior or Ascending Palatine – Dips beneath ramus of jaw. Ascends between stylo-glossus & -pharyngeus and then upon superior constrictor in front of ascending pharyngeal, and supplies tonsil & soft palate.

Tonsillar – Ascends upon and perforates sup. constrictor to tonsil & root of tongue.

Submaxillary – Three or four, to submaxillary gland & surrounding muscles.

Submental – Forwards on under surface of mylo-hyoid, and between it and digastric to symphysis, where ascends upon chin.

Inf. Labial – Forwards beneath depressor anguli oris, below following artery to tissues of lower lip.

Inf. Coronary – Forwards beneath depressor anguli oris, and tortuous course through substance of orbicularis and between it & mucous membrane, anastomosing with its fellow.

Sup. Coronary – Larger and more tortuous; similar course along free edge of upper lip, giving twigs to ala and artery of septum to septum of nose.

Lateralis Nasi – To ala and dorsum of nose.

Angular – To inner canthus, supplying lachrymal sac and anastomosing with nasal branch of ophthalmic.

All these branches anastomose freely with each other, with those of the opposite side, and with the mental, transverse facial, infra-orbital, ophthalmic, sublingual, posterior superior or descending palatine and ascending pharyngeal arteries.

THE SALIVARY GLANDS—2nd Tablet.

SUBMAXILLARY GLAND

Intermediate in size between parotid & sublingual. Presents two portions:

Superficial Portion – The largest.

Covered by – Skin, superficial fascia, platysma, deep fascia, body of lower jaw.
Rests upon – Stylo- & hyo-glossi & mylo-hyoid.
Separated posteriorly from parotid by – Stylo-maxillary ligament.
Grooved posteriorly & above by – Facial artery.

Deep Portion – The smallest.

Prolonged upwards forwards & inwards round Wharton's duct, between mylo-hyoid and hyo- & genio-hyo-glossi & below gustatory nerve.

WHARTON'S DUCT — Upwards forwards & inwards with deep portion of the gland on inner side of sublingual gland, and opens on summit of a small papilla on side of frænum linguæ. Is about 2 inches long, and has much thinner walls than Steno's duct; it receives a few of the ductus Riviniani.

VESSELS & NERVES – *Arteries*, from facial & lingual. – *Nerves*, from submaxillary ganglion, sympathetic & mylo-hyoid branch of inferior dental

SUBLINGUAL GLAND

The smallest, flattened, & almond-shaped.

Projects beneath mucous membrane of floor of mouth in the shape of a firm antero-posterior crest
Lies upon mylo-hyoid by side of frænum linguæ & in sublingual fossa of lower jaw
Has behind it & on its inner side genio-hyo-glossus, gustatory nerve, Wharton's duct & deep portion of submaxillary gland

DUCTUS RIVINIANI — From 8 to 20. Open most of them directly into the mouth, some into Wharton's duct. One, longer than the others, the duct of Bartholin, which is sometimes derived in part from submaxillary gland accompanies the Whartonian duct, and opens into it or near it on floor of mouth

VESSELS & NERVES – *Arteries*, from sublingual & submental branches of facial. – *Nerves*, from gustatory

HYPOGLOSSAL NERVE

Arises by ten or twelve filaments from *groove between anterior pyramid & olivary body* in a line continuous with that of the anterior roots of the spinal nerves. These filaments form two bundles which perforate dura mater separately, and pass together through anterior condyloid foramen.

Passes downwards and forwards between pneumogastric & spinal accessory ns., with former of which it is intimately connected, and between int. jugular vein & int. carotid

Loops round occipital artery and passes forwards across external carotid below post. belly of digastric

Passes beneath posterior belly of digastric & stylo-hyoid and crosses hyo-glossus, near ant border of which it anastomoses with gustatory

Passes beneath mylo-hyoid to muscles & substance of the tongue.

BRS. OF COMMUNICATION — Join with:

G. of the trunk of the pneumogastric;
Sup. cervical g. of the sympathetic;
Loop between the two first cervical ns.
} Arise near base of skull.

Gustatory n. — Arises near ant. border of hyo-glossus.

BRS. OF DISTRIBUTION — Are the:

Descendens Noni — Long & slender. Arises just beneath occipital artery.

Passes downwards & forwards across sheath of carotid vessels. (Sometimes within the sheath, either over or beneath int. jugular vein)

Near middle of neck forms a loop with Communicans Noni, from convexity of which loop, brs. are given off to sterno-hyoid & -thyroid and omo-hyoid

This br. is believed to derive its real origin principally from the 1st & 2nd cervical ns., and to have little more than an apparent origin from the hypoglossal, due to a temporary adhesion of its fibres to those of that nerve. Sometimes, owing to similar adhesions, it appears to arise from the pneumogastric either wholly or in part

Brs. to Thyro-hyoid & Genio-hyoid — Arise on surface of hyo-glossus.

Brs. to Stylo-glossus, Hyo-glossus, Genio-hyo-glossus & substance of the tongue. — Arise beneath mylo-hyoid

LINGUAL or GUSTATORY NERVE.

From posterior or larger division of inferior maxillary.
Between the two pterygoid muscles, where it lies on inner side and in front of inferior dental nerve, and is joined by chorda tympani
Above deep portion of submaxillary gland and along side of tongue, crossing Wharton's duct.
Supplies mucous membrane of mouth and gums, submucous glands, conical and fungiform papillæ and mucous membrane of tongue
Gives sensory branches to submaxillary ganglion, and anastomoses with hypo-glossal nerve on anterior margin of hyo-glossus and near tip of tongue

SUB-MAXILARY GANGLION.

Reddish grey circular body about the size of a pin's head situated between gustatory nerve & deep portion of submaxillary gland. It presents

THREE ROOTS:

Sensory Root – From gustatory nerve by several small filaments.

Motor Root – From facial nerve through chorda tympani.

Sympathetic Root – From plexus around facial artery.

BRS. OF DISTRIBUTION — Five or six to mucous membrane of mouth, Wharton's duct & submaxillary gland

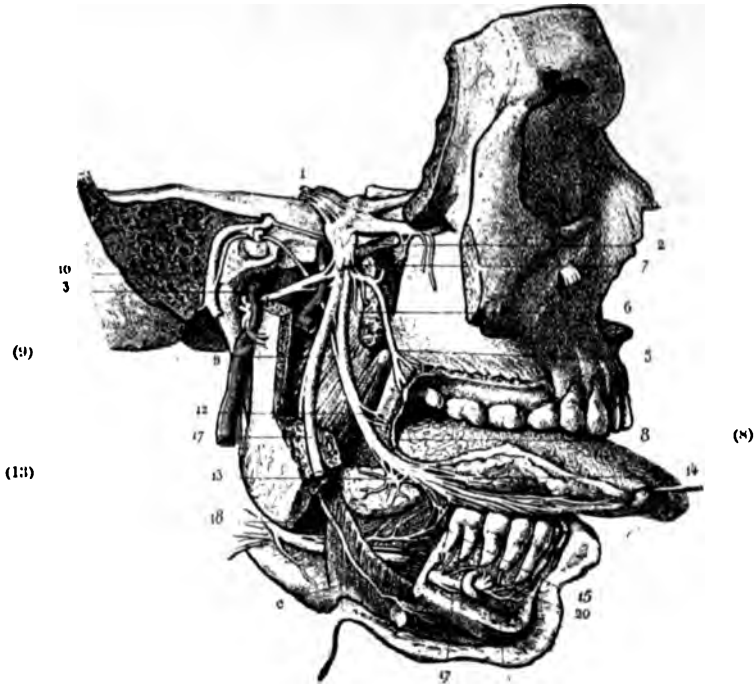


FIG. 403. THE INFERIOR MAXILLARY NERVE. (Hirschfeld.)

(1) Small or motor root of the fifth nerve, passing beneath the sensory root and the Gasserian ganglion, and joining the front part of the inferior maxillary just below the foramen ovale, at 2, whence arise the mixed branches of the nerve (all shown, except the nerve to the internal pterygoid), *i.e.*,

5, buccal nerve;

6, nerve to external pterygoid;

7, masseteric & deep temporal, divided.

(8) Lingual or gustatory nerve, receiving the chorda tympani, 9, which is seen to arise from the facial in the lower part of the aqueductus Fallopii, and to pass, in the tympanum, between the handle of the malleus and the long process of incus.

(13) Submaxillary ganglion; GL, sublingual ganglion sometimes present;

15, anastomosis with the hypoglossal.

(17) Inferior dental nerve (divided), with its mylo-hyoid branch, 18;

19, its incisor branch;

20, its mental branch cut short.

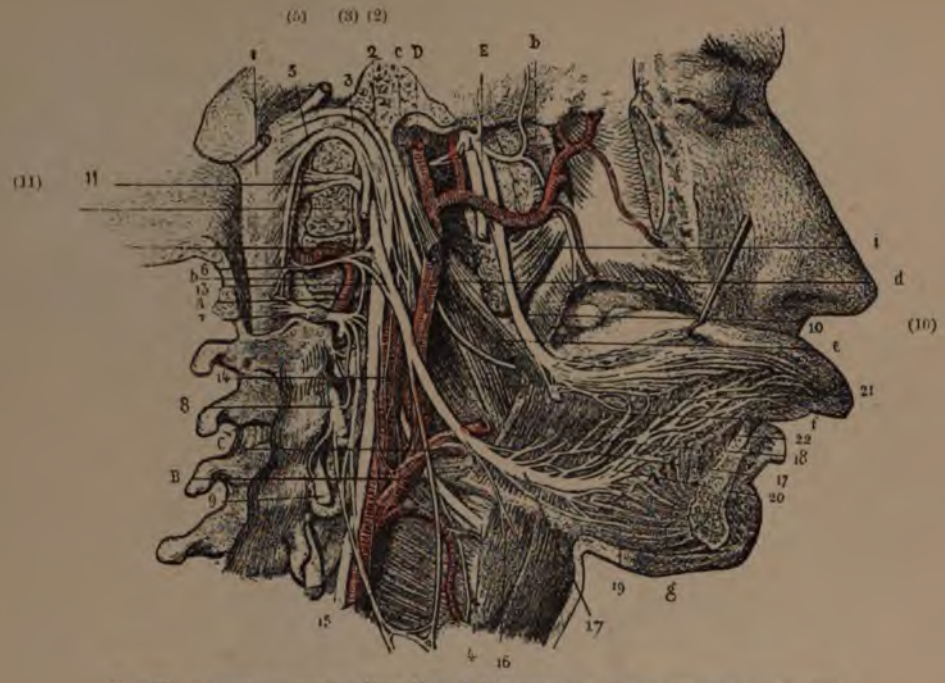


FIG. 404.—ORIGINS OF THE 9TH, 10TH, 11TH, & 12TH NERVES: NERVES SUPPLYING THE TONGUE.

1, the medulla oblongata, showing its lateral aspects.
(2) 9th or glosso-pharyngeal nerve.
(3) 10th or pneumogastric nerve; its superior laryngeal branch, 4.
(5) 11th or spinal accessory nerve;
6, 7, 8, 9, the four first cervical nerves; the two first are thoroughly exposed, and show the ganglia on their posterior roots, - that of the first nerve being quite small.
10) Lingual or gustatory nerve.
11, 17) Hypoglossal nerve, first at its origin, then in the anterior condyloid foramen, and between the spinal accessory & pneumogastric nerves, finally on the hyoglossus muscle.
12, 13, its anastomoses with the first and second cervical nerves;
16, its branch to the thyro-hyoid;
18, 19, 20, its branches to the muscles of the tongue, including its recurrent branch to the stylo-glossus and its loop-like anastomosis with the gustatory;
14, 15, descendens and communicans hypoglossal nerves.

(See expl., p. 228k.)

FIG. 405.—JACOBSON'S AND ARNOLD'S NERVES, AND THEIR COMMUNICATIONS. (Hirschfeld.)

9, petrous ganglion of the glosso-pharyngeal, or ganglion of Andersh;
10, Jacobson's nerve;
11, its filament to the carotid plexus, 12;
13, large deep petrosal nerve joining the large superficial *petrosal, and going with* it to Meckel's ganglion;
14, small deep petrosal nerve joining the small superficial petrosal nerve, 51, and going with it to the otic ganglion, 16
17, 18, 19, branches of distribution of Jacobson's nerve to the fenestra rotunda, fenestra ovalis, and Eustachian tube.

(See expl., p. 228h.)

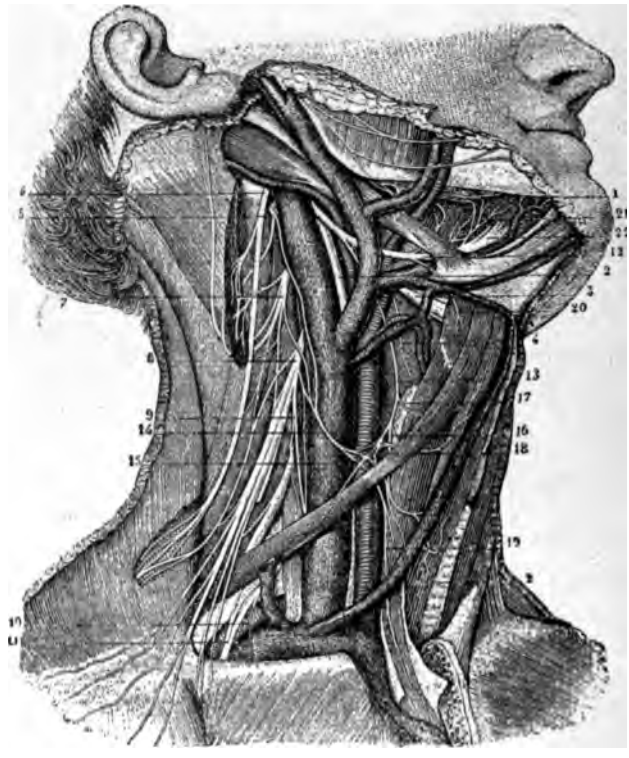


FIG. 406.—DISTRIBUTION OF LINGUAL, PNEUMOGASTRIC, HYPOGLOSSAL, AND SPINAL ACCESSORY NERVES. (Sappey, Hirschfeld.)

1, lingual or gustatory nerve; 12, 22, hypoglossal nerve, with its branch to the thyro-hyoid, 2); 21, its anastomosis with the lingual; 13, descendens cervicis; 14, communicans cervicis; 15, 16, 17, 18, 19, branches from the ansa hypoglossi to the sterno-hyoid and thyroid and omo-hyoid. (See expl., p. 228k.)

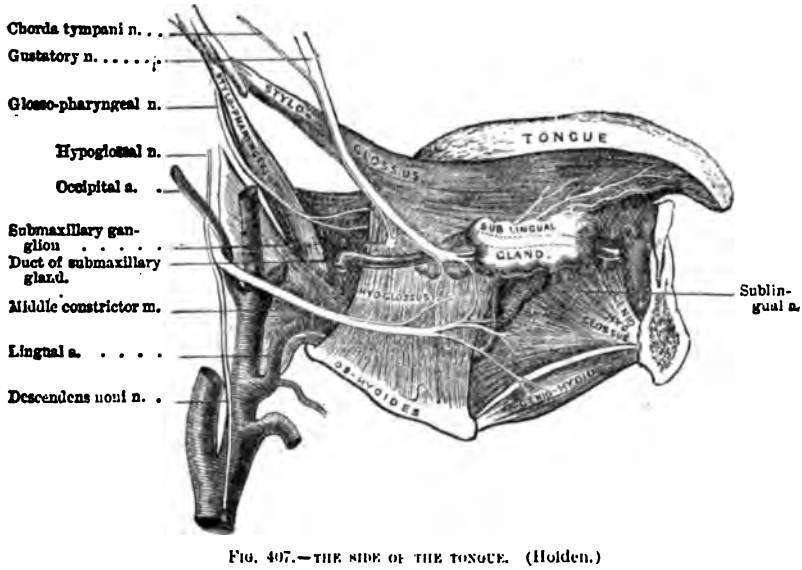


FIG. 407.—THE SIDE OF THE TONGUE. (Holden.)

FIG. 408.—THE DEEP ARTERIES OF THE HEAD AND NECK. (Gray.)

LINGUAL ARTERY.

Arises a little below hyoid bone beneath thin anterior margin of sterno-mast
Upwards & forwards upon middle constrictor to great cornu of hyoid bone.
Horizontally forwards above great cornu beneath hyo-glossus, digastric & stylo-hyoid.
Upwards on genyo-hyo-glossus.
Forwards with gustatory nerve on under surface of linguales inferior, and then bene
mucous membrane to tip of tongue under name of ranine. – Gives off b

Hyoid – Small; along upper border of hyoid bone and joins with its fellow.

Dorsalis Linguæ – Ascends on genyo-hyo-glossus to dorsum of tongue, glottis, soft palate & ton

Sublingual – Forwards between mylo-hyoid & mucous membrane to subling gla

Ranine – The terminal branch; joins with its fellow at tip of tongue.

GLOSSO-PHARYNGEAL NERVE.

Arises from groove between olivary & restiform bodies above pneumogastric.—Is the smallest of the nerves leaving the cranium through the jugular foramen.

Through anterior & inner part of jugular foramen in front of pneumogastric & spinal accessory and in a separate sheath, grooving lower border of petrous portion of temporal bone and presenting two ganglia:

SUP. OR JUGULAR G. OR G. OF THE ROOT — Small, and involves only the outer fibres;

INF. OF PETROUS G. OR G. OF ANDERSCH — Larger, and involves whole of fibres.

Gives off from petrous ganglion:

Tympanic branch or *Jacobson's nerve*, described below;

Anastomotic br. to *ganglion of the root & to auricular br. of the pneumogastric;*

and from a little below the ganglion:

Anastomotic br. to *facial nerve.* — This branch pierces post. belly of digastric.

Downwards & forwards in front of pneumogastric & between int. carotid & int. jugular vein.

Beneath styloid process & muscles connected with it to lower border of stylo-pharyngeus.

Curves inwards upon stylo-pharyngeus & middle constrictor.

Beneath hyo-glossus to mucous membrane of fauces & base of tongue.

BRANCHES:

Tympanic Br. or Jacobson's N. — Arises from petrous ganglion.

Ascends through small canal in petrous bone to tympanum, where divides into:

BRS. OF COMMUNICATION — To *carotid plexus and great & small petrosal branches of facial.*

BRS. OF DISTRIBUTION — To *fenestra rotunda, fenestra ovalis & mucous membrane of Eustachian tube.*

Carotid Brs. — Descend on internal carotid artery, and join pharyngeal brs. of pneumogastric, sup. laryngeal & sympathetic.

Pharyngeal Brs. — Three or four; form pharyngeal plexus by joining opposite middle constrictor with pharyngeal brs. of pneumogastric, sup. laryngeal & sympathetic.

Muscular Brs. — To stylo-pharyngeus & constrictors of pharynx.

Tonsillar Brs. — To tonsil, forming tonsillar plexus, branches of which are distributed to soft palate & fauces

Lingual Brs. — To mucous membrane of base & side of tongue.

THE TONGUE—1st Tablet.

Presents for examination:

BASE – Connected to:

Soft palate – By anterior pillars of fauces;
Pharynx – By superior constrictors of pharynx & mucous membrane;
Epiglottis – By three folds of mucous membrane, the glosso-epiglottic ligaments;
Hyoid bone – By hyo-glossi & genio-hyo-glossi muscles.

APEX – Free.

UPPER SURFACE OR DORSUM — Rough in its anterior two-thirds, where it presents the *papillæ minimæ* or *conicæ et filiformes*, and the papillæ *mediæ* or *fungiformes*; smooth in its posterior third, or behind the papillæ *maximæ* or *circumvallatæ*, where it presents the projecting orifices of numerous mucous glands.

UNDER SURFACE — Connected to hyoid bone & lower jaw by hyo-glossi & genio-hyo-glossi muscles, and from sides of which the mucous membrane is reflected over floor of mouth to inner surface of gums, forming in front a prominent fold, the frænum linguæ.

STRUCTURE of the TONGUE

Presents for examination:

Osteo-fibrous Support – Consists of:

Hyoid Bone;
Median Fibrous Septum – Thickest behind, where it is attached to epiglottis.
Hyo-glossal Membrane – Connects under surface of tongue to hyoid bone.
To these may be added the
Thick mucous Membrane on the dorsum of the organ.

Muscular fibres – Vide next Tablet.

Mucous Membrane – Vide next Tablet but one.

Vessels & Nerves.

Arteries – *Lingual*, inferior or ascending palatine branches of *facial*, *ascending pharyngeal*.
Veins – Partly correspond to arteries, partly open into pterygoid plexus.
Lymphatics – To submaxillary glands.
Nerves – Are the:

- *Gustatory* to mucous membrane of anterior two-thirds.
- *Glosso-pharyngeal* to mucous membrane of posterior third & sides;
- *Hypoglossal* to the muscles.

Internal branch of the superior laryngeal sends a few twigs to mucous membrane of base. — A few small ganglia are found (Kölliker, Remak) upon the glosso-pharyngeal and, in the sheep & calf, upon the gustatory.

Every muscle has ... the tissue ... of ... the ... – ... by ...) is ... and ... .

THE TONGUE—2nd Tablet.

MUSCULAR FIBRES.

Form extrinsic & intrinsic muscles.

EXTRINSIC MUSCLES

Are the:

Stylo-glossus – Anterior & outer aspect of styloid process near its apex & stylo-maxillary ligament.
Side of base of tongue externally to hyo-glossus, dividing into:
LONGITUDINAL PORTION – Forwards along side of tongue, and blends with lingualis inferior in front of hyo-glossus.
TRANSVERSE PORTION – Decussates with hyo-glossus & with its fellow.

Hyo-glossus – Side of body, lesser cornu & whole length of great cornu of hyoid bone (basio-glossus, chondro-glossus, cerato-glossus).
Side of under surface of tongue between stylo-glossus & lingualis inferior.

Genio-hyo-glossus – By a short tendon from superior genial tubercle on inner surface of body of jaw-bone close to symphysis.
Whole length of under surface of tongue internally to lingualis inferior, side of pharynx, body of hyoid bone.

Palato-glossus or **Constrictor Isthmi Faucium** – Anterior surface of soft palate close to uvula.
Side of base of tongue, blending with stylo-glossus.

INTRINSIC MUSCLES

Are the:

Lingualis transversus – Median septum.
Sides, and sides of dorsum. – Forms the chief bulk of the tongue.

Lingualis Superior – Stratum of longitudinal or slightly oblique fibres thickest in front, and covering dorsum of tongue beneath the mucous membrane to which the individual fibres are attached.

Lingualis Inferior – Longitudinal band of fibres along whole length of under surface of tongue between hyo-glossus & genio-hyo-glossus.
Blends with stylo-glossus in front of hyo-glossus.

Lingualis Perpendicularis – Set of vertical or slightly oblique fibres from central part of dorsum to sides of under surface, forming curves concave upwards & outwards.

The outer parts, or cortex, of the tongue are firm, and consist mainly of longitudinal fibres; the central part, or nucleus, is softer, and consists mainly of transverse & vertical fibres intermingled with adipose tissue.

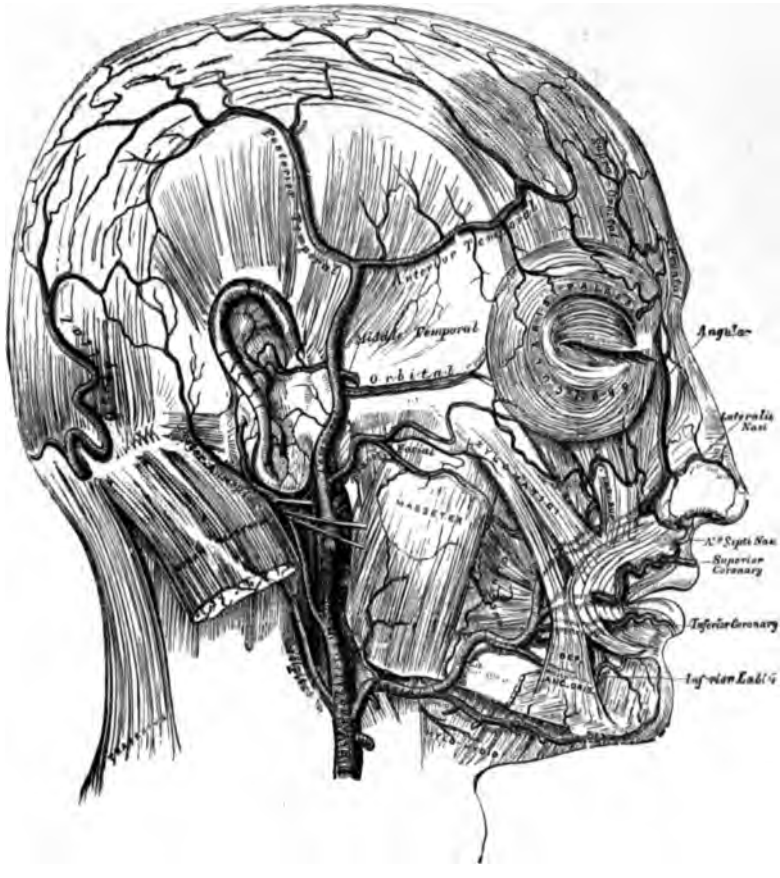


FIG. 409 – THE ARTERIES OF THE SCALP AND FACE. (Gray.)

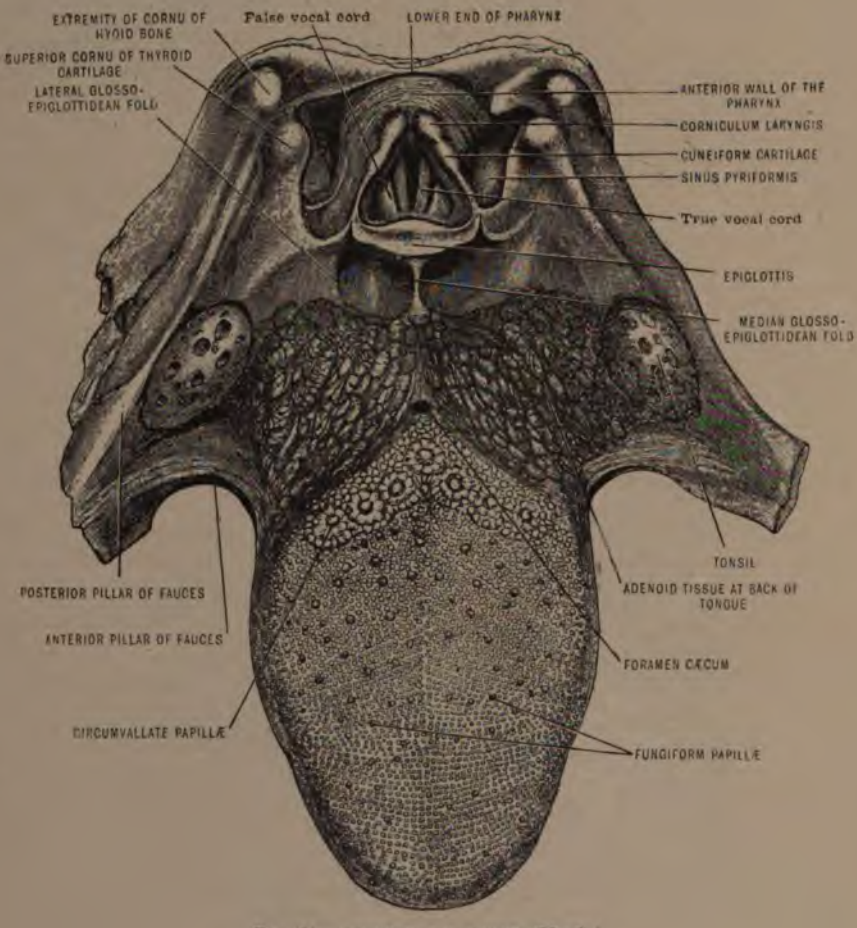


FIG. 410.—DORSUM OF THE TONGUE. (Morris.)

THE TONGUE—3rd Tablet.

MUCOUS MEMBRANE.

Thick & rough on anterior two-thirds of dorsum, sides, & tip; thin & smooth on posterior third of dorsum & on under surface.

Consists of a cutis or corium dense & very similar to that of the skin, and of a thick layer of squamous epithelium; and presents:

PAPILLÆ — Highly sensitive vascular projections divisible into simple and compound. The former are similar to the papillæ of the skin, and cover whole of tongue; the latter, which are themselves studded with simple papillæ, are found on rough surface only, and are divided according to their size & shape into:

Papillæ Maximæ or Circumvallatæ – From 7 to 12; situated at junction of middle & posterior thirds of dorsum, where they are arranged in two rows oblique backwards & inwards, which rows meet at foramen cœcum and form together an inverted V. They consist of a central conical projection, the base of which is free while its apex is attached, which projection is contained in a cup-shaped depression bounded itself by a prominent circular rim. – The foramen cœcum is the central depression, usually large, which lodges the central papilla, itself frequently small.

Papillæ Mediæ or Fungiformes – Club-shaped, and present narrow attached & rounded free extremities. Sparingly scattered over anterior two-thirds of dorsum, collected in greater numbers over sides & tip.

Papillæ Minimæ, or Conicæ et Filiformes – Tapering or cylindrical, closely packed over whole of rough surface, and arranged in rows which are vertical on borders & tip, and which are, on dorsum, parallel, posteriorly, to the rows of circumvallate papillæ, but, anteriorly, more directly transverse. – The simple or secondary papillæ borne by the filiform papillæ contain a few elastic fibres, and their epithelial sheaths are prolonged beyond them sometimes to the extent of forming a pencil of almost hair-like fibres.

In the fungiform & circumvallate, and probably also in the filiform papillæ, the nerves form plexuses, from which small brush-like filaments are given off to the secondary papillæ. These filaments are believed to terminate in the deep extremities of spindle-shaped nucleated bodies similar to the olfactory cells of Shultze (Billroth, Key).

GLANDS — Are:

Follicular – Aggregated on posterior third of dorsum behind papillæ circumvallatæ, and very similar to the follicular recesses of the tonsils.

Racemose – Lie beneath & in front of foregoing, and over sides & under surface of tongue. On under surface near tip they are collected into two small oblong masses first described by Blandin & Nuhn.

THE TASTE-BUDS.

Are flask-like bodies discovered by Loven & Schwalbe in the thick epithelial layer which surrounds the sides of the circumvallate papillæ of the base of the tongue, and which have also been found of late on some of the fungiform papillæ and on the epiglottis. They are pyriform in shape. Their bases rest upon the chorium. Their apices project between the superficial epithelial cells, and present a minute opening, from which a bundle of thread-like processes are seen to emerge.

They consist of modified epithelial cells, disposed perpendicularly to the surface, which cells may be divided into superficial & deep. The *superficial cells* are flattened, or ribbon-like, tapering at each end, and joined together at their sides, so as to enclose the deeper cells, as, in the flower-bud, the external scales surround the internal folioles. The *deeper cells* are spindle-shaped, enlarged in their middle, where they present a prominent nucleus, and tapering at either end. Their deeper end, which is sometimes branched, passes down into the chorium, and, it is said, becomes connected with a nerve-fibril. Their more superficial end is prolonged into one of the thread-like processes, which are seen to project from the opening of the taste-bud. The surrounding epithelial cells are flattened around the taste-buds, so as to enclose them in a sac or nest.

The taste-buds are now believed not to be connected with the sense of taste, since they are found on the epiglottis, which is not endowed with taste.

HEAD & NECK.

VI.

THE ORBIT.

THE ORBIT.

Quadrilateral pyramidal fossa looking forwards & outwards and formed by seven bones, the frontal, ethmoid, sphenoid (which enter into formation of both orbits), superior maxillary, malar, lachrymal & palate.

Communicates with cranium, and with nasal, temporal, zygomatic & spheno-maxillary fossæ through optic foramen, nasal duct & spheno-maxillary fissure.

Presents:

ROOF — Formed by orbital plate of frontal & lesser wing of sphenoid. Is concave, and presents the suture between the foregoing bones, and in front the

Lachrymal fossa for lacrymal gland, and a

Depression (fovea trochlearis) for pulley of superior oblique.

FLOOR — Formed by upper or orbital surface of superior maxillary and orbital processes of malar & palate bones. Presents the sutures between foregoing bones, the

Infra-orbital groove for infra-orbital vessels & nerve, which becomes converted in front into *Infra-orbital canal;* and also at its anterior & inner part a

Depression for inferior oblique muscle.

INNER WALL — Formed from before backwards by nasal process of superior maxillary, lachrymal, os planum of ethmoid, body of sphenoid. Is antero-posterior in direction and parallel to its fellow, and presents the sutures between foregoing bones and the

Lachrymal groove for lachrymal sac,

Crest of lachrymal bone for tensor tarsi muscle.

OUTER WALL — Formed in front by orbital process of malar bone, and behind by anterior or orbital surface of great wing of sphenoid. Is very oblique forwards & outwards being nearly at right angles with its fellow, and presents the suture between foregoing bones, and the

Orifices of one or two malar canals,

Small spine for lower head of external rectus.

ANGLES:

SUP. EXTERNAL – Presents:

Articulation of frontal with malar bone & orbital plate of sphenoid,

Sphenoidal fissure or *foramen lacerum anterius* for 3rd, 4th & 6th nerves and ophthalmic nerve & vein.

SUP. INTERNAL – Presents

Suture connecting frontal with lachrymal & os planum, in which suture are the *Anterior ethmoidal canal* for nasal nerve & anterior ethmoidal vessels, and the *Posterior ethmoidal canal* for posterior ethmoidal vessels.

INF. EXTERNAL – Presents

Spheno-maxillary fissure for infra-orbital vessels & nerve and ascending branches of Meckel's ganglion.

INF. INTERNAL – Presents

Articulation of superior maxillary & palate bones with lachrymal & os planum.

CIRCUMFERENCE OR BASE — Quadrilateral, looks forwards & outwards. Is bounded by supra-orbital arch and external & internal angular processes of frontal, anterior border of orbital surface & nasal process of superior maxillary, and anterior border of malar bone. Presents

Supra-orbital notch or foramen for supra-orbital vessels & nerve; and assists in forming *Lachrymal groove* for lachrymal sac.

APEX — Corresponds to optic foramen for optic nerve & ophthalmic artery.

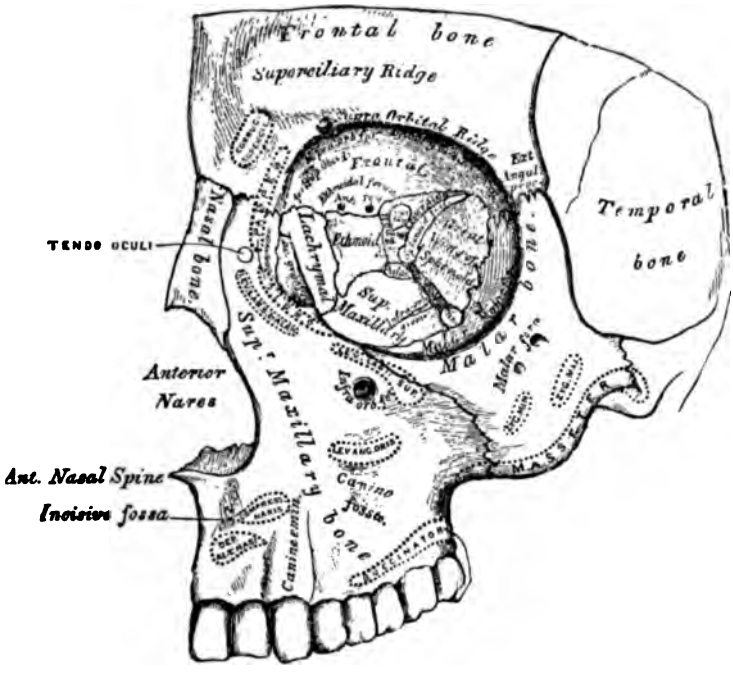


FIG. 411.—THE BONY ORBIT. (Gray.)
(See also Fig. 38, p. 84, of Part I.)

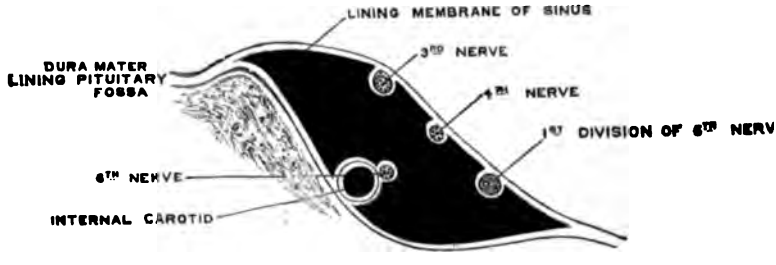


FIG. 412.—RELATIONS OF STRUCTURES IN THE CAVERNOUS SINUS. (Gray.)

FIG. 413.—MEDULLA, PONS, CRURA CEREBRI, AND OTHER CENTRAL PARTS OF THE BRAIN, SHOWING APPARENT ORIGINS OF THE CRANIAL NERVES, THE SECOND AND THE FOURTH EXCEPTED. (Quain.)

The nerves are marked in Roman figures, I. to IX., according to Willis's classification. II., optic nerve, with the optic tract. II'., and the internal and external geniculate bodies, *i*, *e*; III., third nerve or motor oculi; IV., fourth nerve, trochlearis or patheticus; V., the two roots, anterior small or motor, and posterior large or sensory, of the fifth nerve; VI., sixth nerve; VII., facial nerve, with the auditory nerve, marked *b*, to its outer side; VIII., pneumogastric nerve, with the glosso-pharyngeal nerve, marked *a*, above it, and the spinal accessory nerve, marked *b*, below it; *pa*, anterior pyramid; *o*, olivary body.

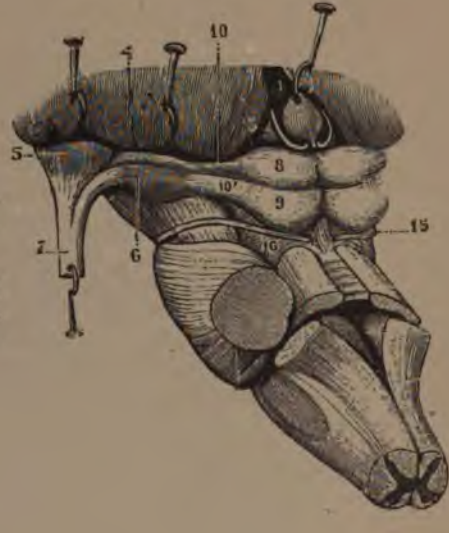


FIG. 414.—THE SAME PARTS SEEN FROM BEHIND, SHOWING THE APPARENT ORIGINS OF THE SECOND AND FOURTH NERVES. (Testut.)

8 and 9, anterior and posterior quadrigeminal bodies with 10 and 10', their respective brachia; 5 and 6, internal and external geniculate bodies; 7, optic tract; 15, 16, apparent origin of fourth nerve from upper part of valve of Vieussens.

(For deep origins of the above nerves, see pp. 152k to w.)

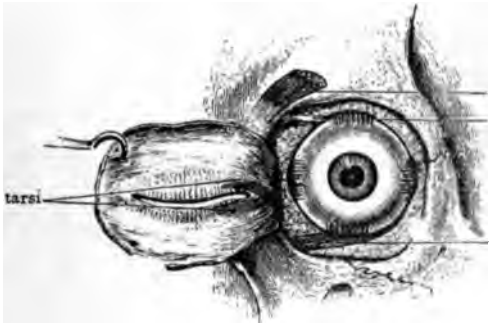


FIG. 415.—THE TENSOR TARSI AND OTHER MUSCLES OF THE ORBIT. (Morris.)

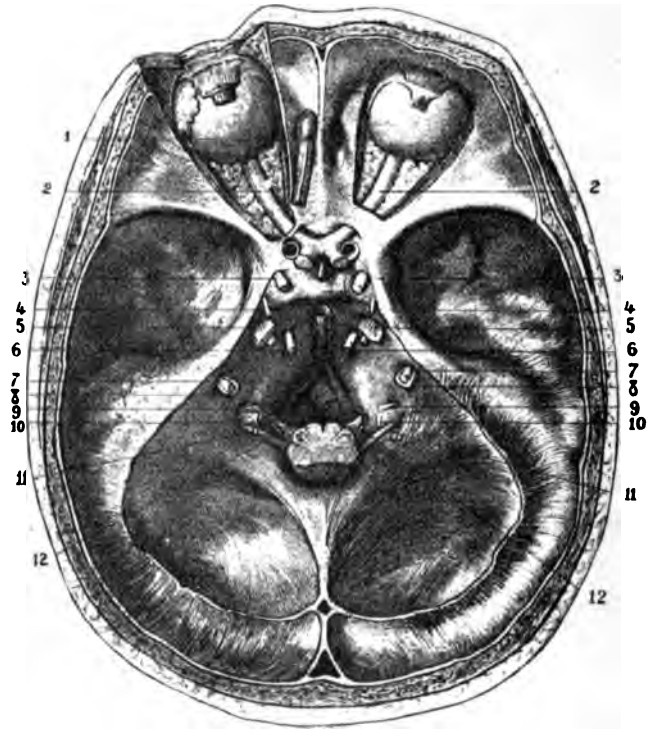


FIG. 416.—THE CRANIAL NERVES PIERCING THE DURA MATER. (Hirschfeld.)

The nerves are marked in common figures, 1 to 12, according to Sömmering's classification.

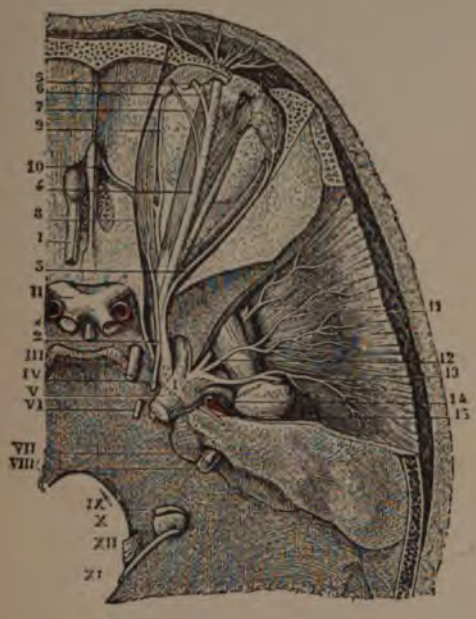


FIG. 417.—GASSERIAN GANGLION AND SUPERFICIAL NERVES OF ORBIT. (Sappey, Hirschfeld.)

III., IV., V., VI., third, fourth, fifth, and sixth nerves; 2, ophthalmic nerve; 3, 4, 8, lachrymal, frontal, & nasal nerves. Fourth nerve is seen on inner side of ophthalmic, and motor root of fifth beneath the sensory root. (See expl., p. 228l.)

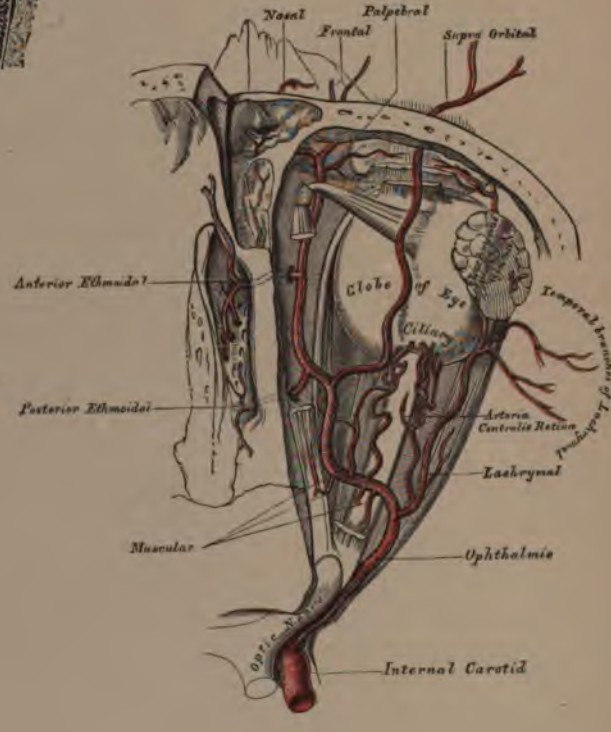


FIG. 418.—THE OPHTHALMIC ARTERY AND ITS BRANCHES. (Gray.)

FOURTH NERVE, TROCHLEARIS or PATHETICUS.

F. 417 (P 203 a)
F. 417 (P 202 b)

Arises from upper part of valve of Vieussens immediately behind the testis. Is the smalles
of the cranial nerve
Crosses processus e cerebello ad testes and winds round under surface of crus cereb
immediately in front of pons Varol
Pierces dura mater in free border of tentorium cerebelli near posterior clinoid process.
Through outer wall of cavernous sinus below 3rd nerve and above ophthalmic branch
the 5th, receiving filaments from ophthalmic branch & from carotid plexu
Through highest and broadest part of sphenoidal fissure.
Inwards above levator palpebræ superioris to orbital surface of superior oblique.

FIFTH NERVE.

Fig 413

Arises by two roots, anterior small or motor, posterior large or sensory, from *side of pons Varolii nearer to upper than to lower border.*

Through opening in dura mater near apex of petrous portion of temporal bone. Sensory root to Gasserian ganglion; motor root to inferior maxillary nerve outside cranium.

Gasserian ganglion – Crescentic. Situated in a depression near apex of petrous portion of temporal bone, and receives filaments from carotid plex. Gives off anteriorly ophthalmic, superior & inferior maxillary nerves, and laterally, small branches to tentorium cerebelli & dura mater of middle fossa, and one to 6th nerve in cavernous sinus.

OPHTHALMIC NERVE — The smallest of the three divisions of the 5th pair.

Through outer wall of cavernous sinus below 3rd & 4th nerves, being joined by filaments from cavernous plexus and frequently from 4th nerve, and giving off recurrent branches to tentorium

Divides near sphenoidal fissure into lachrymal, frontal, nasal.

LACHRYMAL N. — The smallest.

Through outer & narrowest part of sphenoidal fissure, and along upper border of external rectus to lachrymal gland, conjunctiva & skin of upper eyelid. — Joins with orbital branch of superior maxillary nerve.

FRONTAL N. — The largest.

Through highest & broadest part of sphenoidal fissure;

Along middle line of orbit between levator palpebræ superioris & periosteum, and divides into

SUPRAORBITAL BR. — The largest. Through supraorbital foramen or notch and ascends to corrugator supercilii, occipito-frontalis & orbicularis palpebrarum, and to periosteum & integument, the cutaneous branches, two in number, lying at first beneath the muscles

SUPRATROCHLEAR BR. — The smallest. Above pulley of superior oblique and same destribution. Joins with infratrochlear branch of nasal

NASAL N.—Intermediate in size. Vide p. 207.

THIRD NERVE or MOTOR OCULI.

Arises from inner border of crus cerebri immediately in front of pons Varolii.

Pierces dura mater on outer side of and a little behind, anterior clinoid process.

Through outer wall of cavernous sinus above 4th nerve & ophthalmic branch of 5th, being joined by filaments from cavernous plexus

Divides into superior & inferior branches, which pass through sphenoidal fissure between the two heads of external rectus

SUPERIOR BR. – The smallest. Inwards above optic nerve to *levator palpebræ superioris* & *superior rectus*

INFERIOR BR. – The largest. To *internal* & *inferior recti and inferior oblique.* –

SHORT or MOTOR ROOT OF LENTICULAR GANGLION is derived from nerve to inferior oblique

MUSCLES.

ORIGINS.

Internal & Inferior Recti & Lower Head of External Rectus – Incomplete fibrous ring termed the ligament of Zinn, which surrounds optic foramen, except at its upper & outer part. – Lower head of external rectus also arises from a small spine on orbital surface of greater wing of sphenoid.

Superior Rectus & Upper Head of External Rectus – Upper margin & upper part of outer margin of optic foramen.

Levator Palpebræ Superioris – Under surface of lesser wing of sphenoid in front of optic foramen & externally to superior oblique.

Superior Oblique – Under surface of lesser wing of sphenoid in front of optic foramen & internally to levator palpebræ superioris.

Inferior Oblique – Depression on orbital plate of superior maxilla close to lachrymal groove.

INSERTIONS.

The Four Recti – Fore part of sclerotic about four lines from cornea.

Superior & Inferior Oblique – Upper & outer part of sclerotic between superior & external recti and midway between cornea & optic nerve.

Levator Palpebræ Superioris – Upper border of superior tarsal cartilage.

NERVE-SUPPLY — Levator palpebræ superioris & superior rectus, *upper division of 3rd nerve;* – internal & inferior recti and inferior oblique, *lower division of 3rd nerve:* – superior oblique, *4th nerve;* – external rectus, *6th nerve.*

NASAL NERVE.

Intermediate in size between the lachrymal & frontal.

Between the two heads of external rectus, and forwards & inwards across optic nerve.

Through anterior ethmoidal foramen, and through groove on cribriform plate & slit by crista galli to nose, where divides into

INTERNAL BR. — To mucous membrane of fore part of septum;

EXTERNAL BR. — In groove on inner surface of nasal bone, between that bone & lateral cartilage, and downwards to tip of nose beneath compressor nasi supplying mucous membrane & integument.

Gives off:

GANGLIONIC BR. — Long & slender; to posterior superior angle of ciliary ganglion, forming its long or sensory root.

LONG CILIARY NS. — Two or three; join ciliary nerves from ciliary ganglion. (Vide Ciliary Ganglion).

INFRATROCHLEAR BR. — Beneath pulley of superior oblique, where joins with supratrochlear branch of frontal, to orbicularis, lachrymal sac, carunculæ, conjunctiva & skin of eyelids.

CILIARY, OPHTHALMIC or LENTICULAR GANGLION.

Reddish grey quadrangular body of the size of a pin's head situated at back of orbit on outer side of optic nerve. — Presents:

THREE ROOTS:

Sensory, or Long & Slender Root — From *nasal branch of ophthalmic* to posterior superior angle of ganglion; is accompanied by the sympathetic root, which is sometimes blended with it.

Motor, or Short & Thick Root — From *branch of 3rd nerve to inferior oblique* to posterior inferior angle; is occasionally divided into two parts.

Sympathetic Root — Long & slender filament from *cavernous plexus;* accompanies sensory root, with which it is sometimes blended.

BRS. OF DISTRIBUTION:

Ciliary Ns. — Ten or twelve from anterior angles of ganglion, forming a small superior & a large inferior bundle;

Forwards above & below optic nerve with ciliary branches of nasal;

Through back part of sclerotic, and in grooves on its inner surface to ciliary muscle, cornea & iris.

)PHTHALMIC ARTERY.

Arises from internal carotid as that vessel emerges from cavernous sinus between optic nerve & anterior clinoid process.

Through optic foramen below & on outer side of optic nerve.

Over optic nerve, and forwards beneath superior oblique to superior internal angle of orbit, where divides into frontal & nasal.

BRANCHES — May be divided into:

ORBITAL GROUP:

Lachrymal – With lachrymal nerve & above external rectus to lachrymal gland & upper eyelid. Gives off small malar & temporal branches, which perforate malar bone to temporal fossa & cheek.

Supraorbital – With frontal nerve & above the muscles to supraorbital foramen, where divides into superficial & deep branches to integument & muscles of forehead & pericranium.

Ethmoidal – Anterior & posterior. Through anterior & posterior ethmoidal foramina (former with nasal nerve), giving branches to ethmoidal cells & dura mater, and then through foramina in cribriform plate of ethmoid to septum & outer wall of nose.

Palpebral – Superior & inferior. Encircle eyelids near free margin & beneath orbicularis, and anastomose with infraorbital & with orbital branch of temporal.

Frontal – From orbit at its superior internal angle to skin & muscles of forehead & pericranium, joining with supraorbital.

Nasal – Above tendo oculi, and divides into dorsalis nasi to dorsum of nose and anastomotic branch to angular branch of facia.

OCULAR GROUP:

Muscular – Very variable, usually divided into:

SUPERIOR – Smaller, to levator palpebræ superioris, superior rectus & superior oblique;

INFERIOR – Larger, to inferior oblique & the other recti, and gives off most of the anterior ciliary arteries.

Ciliary – May be divided into:

SHORT POSTERIOR – Surround optic nerve, and through sclerotic a line or two from the nerve to ciliary processes & choroid.

LONG – Two. Through back part of sclerotic, and between sclerotic & choroid on either side of eyeball to ciliary body, where bifurcate and form great arterial circle of iris, from which small twigs converge to free margin of iris forming lesser arterial circle.

ANTERIOR – Chiefly from muscular. Through sclerotic a line or two from margin of cornea to great arterial circle of iris.

Centralis Retinæ – Pierces optic nerve, and forwards in its substance to retina. In fœtus a small branch passes forwards through vitreous body to posterior part of capsule of lens.

SECOND or OPTIC NERVE.

(*Dissectional description; see new description, page* 228d, *and note, page* 315.)

Presents for examination the optic tract, the optic commissure & the optic nerve proper.

OPTIC TRACT

Begins in the *anterior & posterior quadrigeminal bodies* by two distinct bundles of fibres, which pass between the *corpora geniculata internum et externum*, become respectively connected with and receive fibres from the latter, unite, and receive additional fibres from the *optic thalamus*.

Winds obliquely forwards across under surface of crus cerebri, being flattened in shape and slightly attached to the crus by its anterior margin.

Leaves the crus as a round bundle and becomes connected with the *lamina cinerea & the tuber cinereum*.

Joins its fellow to form optic commissure.

OPTIC COMMISSURE or CHIASMA

Is formed as follows:

A few of the outer fibres of each optic tract pass into the optic nerve of the same side.

The mass of the fibres decussate, and pass into the optic nerve of the opposite side.

A few of the innermost fibres, termed the inter-cerebral fibres, pass back to the cerebrum, forming the posterior fibres of the commissure and the innermost fibres of the optic tract of the opposite side.

A few similar fibres, termed the inter-retinal fibres, pass along the anterior border of the commissure from one optic nerve to the other.

OPTIC NERVE

Through optic foramen, being surrounded by a tubular process of the dura mater, which, as the nerve enters the orbit, subdivides, and both continues the sheath of the optic nerve, and forms the periosteum of the orbit.

Pierces sclerotic and choroid about one tenth of an inch to the inner side of the axis of the eye, and expands into the retina. – The arteria centralis retinæ pierces the optic nerve, and runs forwards in its substance to the retina.

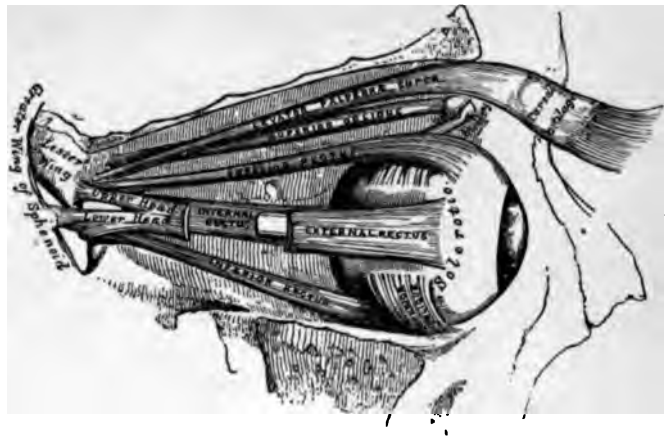


Fig. 419. THE MUSCLES OF THE ORBIT FROM THE OUTER SIDE. (Gray.)

Fig. 420.—MUSCLES OF THE ORBIT FROM ABOVE. (Hirschfeld.)

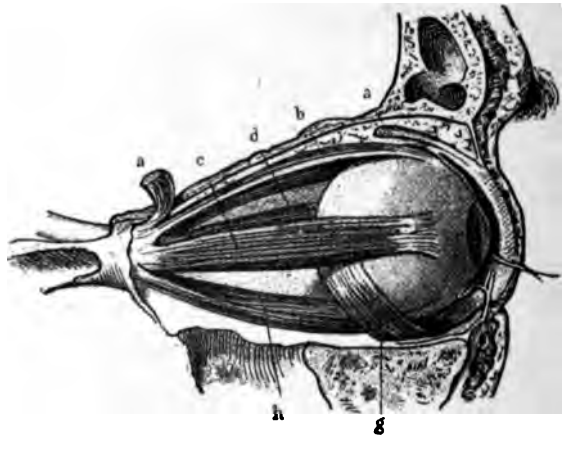


Fig. 421. MUSCLES OF THE ORBIT FROM THE OUTER SIDE. (Hirschfeld.)

In both Figures: *a*, levator palpebræ superioris; *b*, *c*, *d*, superior, external, and internal recti; *e*, *f*, superior oblique and its pulley; *g*, inferior oblique; *h*, inferior rectus.

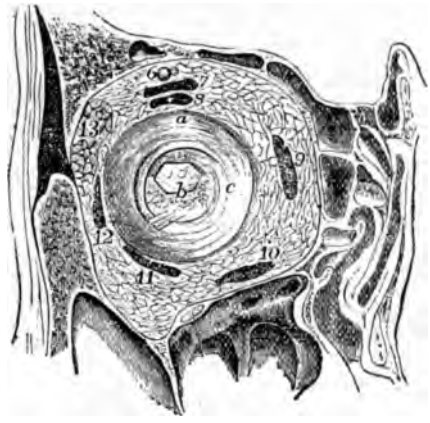


FIG. 422.—EQUATORIAL SECTION, SHOWING BACK PART OF TENON'S CAPSULE. (Henle, Wilson.)

a, *c*, cut edge and cavity of Tenon's capsule; *b*, optic nerve, with small portion of sclerotic; 7, 8, 9, 10, 12, 11, lev. palp. sup., sup., int., inf., & ext., recti, and inf. oblique ms.; 13, lachrym. gld.

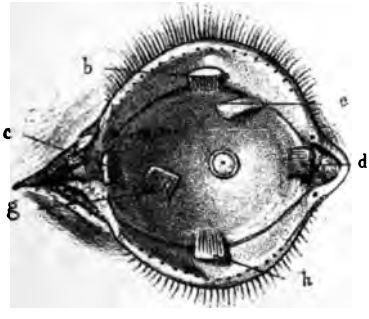


FIG. 423.—BACK PART OF TENON'S CAPSULE SEEN FROM THE FRONT. (Hirschfeld.)

In both Figures: *a*, levator palpebræ superioris; *b*, *c*, *d*, superior, external and internal recti; *e*, *f*, superior oblique and its pulley; *g*, inferior oblique; *h*, inferior rectus.

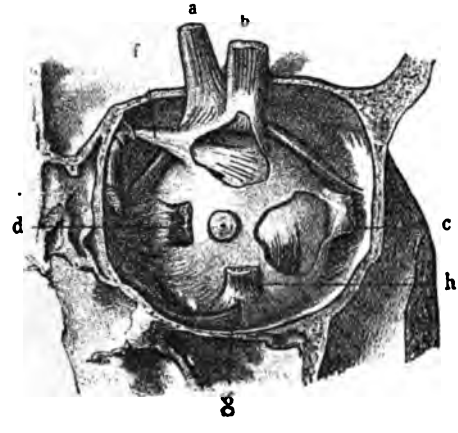


FIG. 423A.—TENON'S CAPSULE SEEN FROM BEHIND. (Hirschfeld.)

(SEE NOTES, PAGE 228d.)

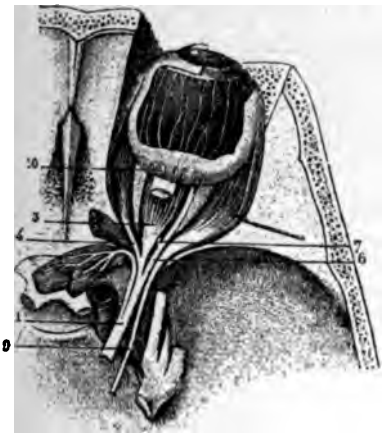


Fig. 121. DEEP NERVES OF THE ORBIT. (Sappey.)

1, third nerve, with its deep division; 9, sixth nerve; 10, ciliary nerves. (See expl., p. 228l.)

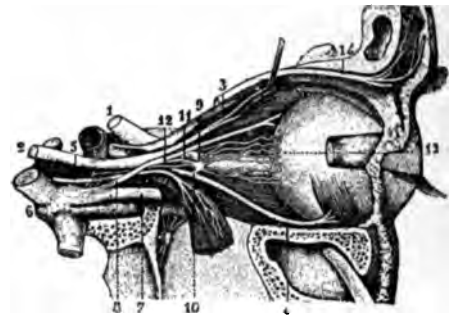


Fig. 425. NERVES OF THE ORBIT FROM THE OUTER SIDE. (Sappey.)

1, optic nerve; 2, third nerve; 5, sixth nerve; 6, Gasserian ganglion; 7, ophthalmic nerve; 8, nasal nerve; 9, lenticular ganglion. (See expl., p. 228l.)

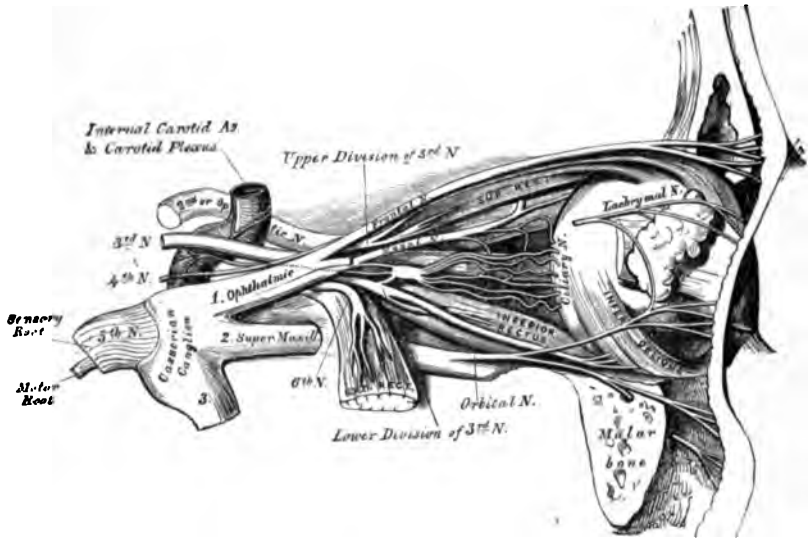


Fig. 426.—THE NERVES OF THE ORBIT SEEN FROM THE OUTER SIDE. (Gray.)

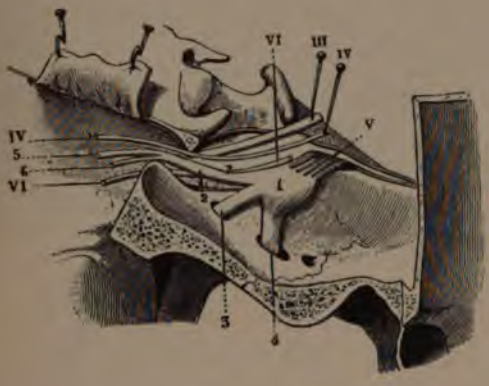


FIG. 427.—ORBITAL NERVES IN THE CAVERNOUS SINUS AND SPHENOIDAL FISSURE. (Testut.)

The nerves are marked with the corresponding Roman figures: 1, Gasserian ganglion; 2, 3, 4, ophthalmic, superior & inferior maxillary nerves; 5, 6, frontal and lachrymal nerves.

FIG. 428.—THE NERVES OF THE ORBIT SEEN FROM ABOVE. (Gray.)

SIXTH NERVE or ABDUCENS.

Arises by several filaments from *constricted part of corpus pyramidale* close to pons Varoli
or from *lower border of pons itself.* — Deep origin is from a grey nucleus on floo
of 4th ventricle
Pierces dura mater on basilar groove immediately below posterior clinoid process.
Forwards on floor of cavernous sinus on outer side of internal carotid artery, receivin
filaments from carotid plexus, Meckel's ganglion & ophthalmic nerve
Through sphenoidal fissure beneath the other nerves & above ophthalmic vein, receivin
filaments from sympathetic
Between the two heads of external rectus to ocular surface of that muscle.

RELATIONS of the NERVES of the ORBIT.

CAVERNOUS SINUS:

Third & Fourth Ns. & Ophthalmic br. of Fifth — Pass through outer wall of cavernous sinus in their numerical order both from above downwards and from within outwards

Sixth N. — Lies on floor of cavernous sinus on outer side of internal carotid artery, on inner side of ophthalmic nerve

SPHENOIDAL FISSURE:

Fourth N., Frontal & Lachrymal Divisions of Ophthalmic N. — Enter orbit above external rectus

The other Ns. — Pass between the two heads of external rectus in following order from above downwards: *Superior division of 3rd N., Nasal branch of Ophthalmic, Lower division of 3rd N., Sixth Nerve*

ORBIT:

Fourth N., Frontal & Lachrymal Divisions of Ophthalmic N. — Lie above the muscles immediately beneath periosteum

The other Ns. — Are found in the following order from above downwards: *Superior division of 3rd N., Nasal branch of Ophthalmic* crossing optic N., *Optic N.* having lenticular ganglion on its outer side, *Inferior division of the 3rd N., Sixth Nerve*

HEAD & NECK.

VII.

PHARYNX & SOFT PALATE.

BACK OF NECK.

THE PHARYNX.

Is a musculo-membranous bag extending from base of skull to lower border of cricoid cartilage in front & 5th cervical vertebra behind; about 4½ inches long; broadest from side to side, its greatest breadth being comprised between cornua of hyoid bone

It is bounded above by petrous portion of temporal bone and by under surface of body of sphenoid; – not, as has hitherto been stated, by basilar process of occipital, the recti capitis antici muscles passing forwards between roof of pharynx & whole length of that process (Thomson & Cleland).

It is continuous below with œsophagus.

It is connected behind by loose areolar tissue to the cervical vertebræ & the longi colli & recti capitis antici muscles.

In front it is attached from above downwards to:

Internal pterygoid plate;
Pterygo-maxillary ligament;
Lower jaw;
Base of tongue;
Cornua of hyoid bone & stylo-hyoid ligament;
Thyroid & cricoid cartilages.

Laterally it is in relation with styloid process, styloid & pterygoid muscles, internal carotid artery, internal jugular vein, glosso-pharyngeal, pneumogastric, spinal accessory, hypoglossal & sympathetic nerves; and also, below, with lateral lobes of thyroid gland, common carotid artery & sterno-hyoid, and, in front, with hyo-glossus muscle and lingual artery & nerve.

It presents seven openings: – nares, Eustachian tubes, mouth, larynx, œsophagus.

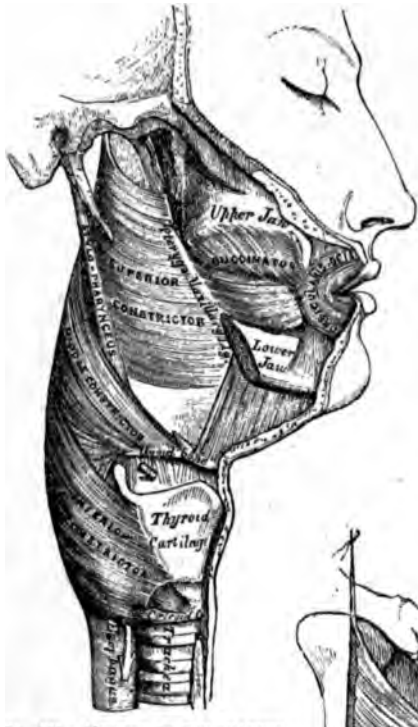


FIG. 429.—MUSCLES OF THE PHARYNX. (Gray).

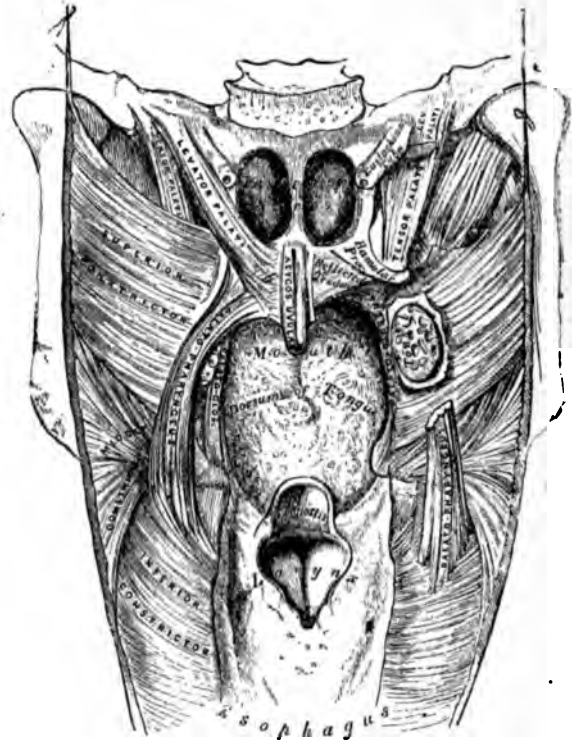


FIG. 430.—MUSCLES OF THE SOFT PALATE. (Gray.)

FIG. 431.—THE SMALL POSTERIOR CRANIO-VERTEBRAL MUSCLES. (Sappey.)

1, 2, recti capitis postici major and minor; 3, 4, inferior and superior oblique. The first and last are partly cut away on right side.

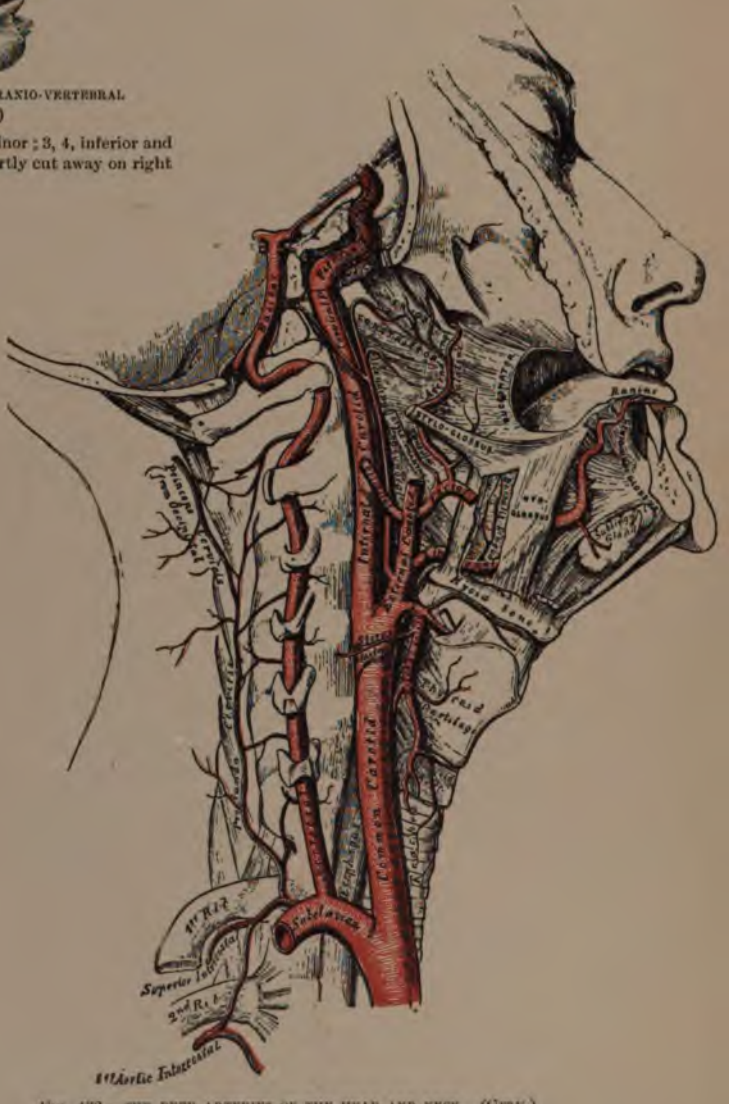


FIG. 432.—THE DEEP ARTERIES OF THE HEAD AND NECK. (Gray.)

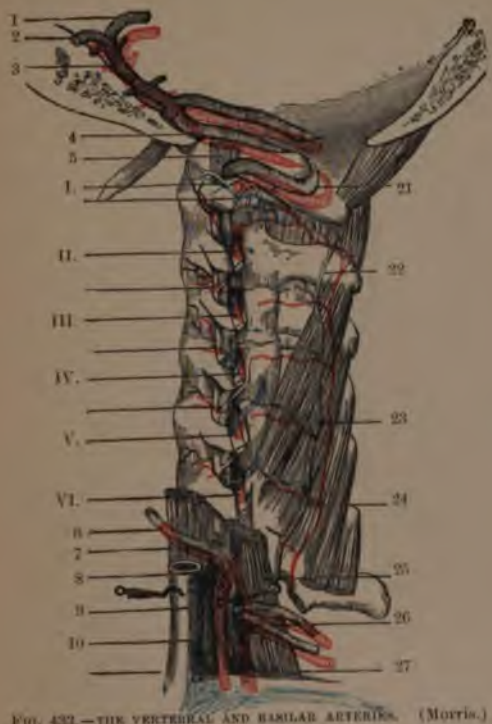


Fig. 432.—The vertebral and basilar arteries. (Morris.)

(See expl., p. 228o.)

Fig. 434.—The suboccipital region. (Heath.)

1, occipital artery & great occipital nerve piercing trapezius; 6 & 8, recti capitis postici minor and major; 10 & 13, superior & inferior oblique; 3, occipital artery; 5, vertebral artery; 7, suboccipital nerve; 9, great occipital nerve winding round inferior oblique. (See expl., p. 228o.)

Fig. 435.—Muscles of the soft palate. (Sappey.)

1 azygos uvulæ; 2, levator palati; 3, palato-pharyngius.

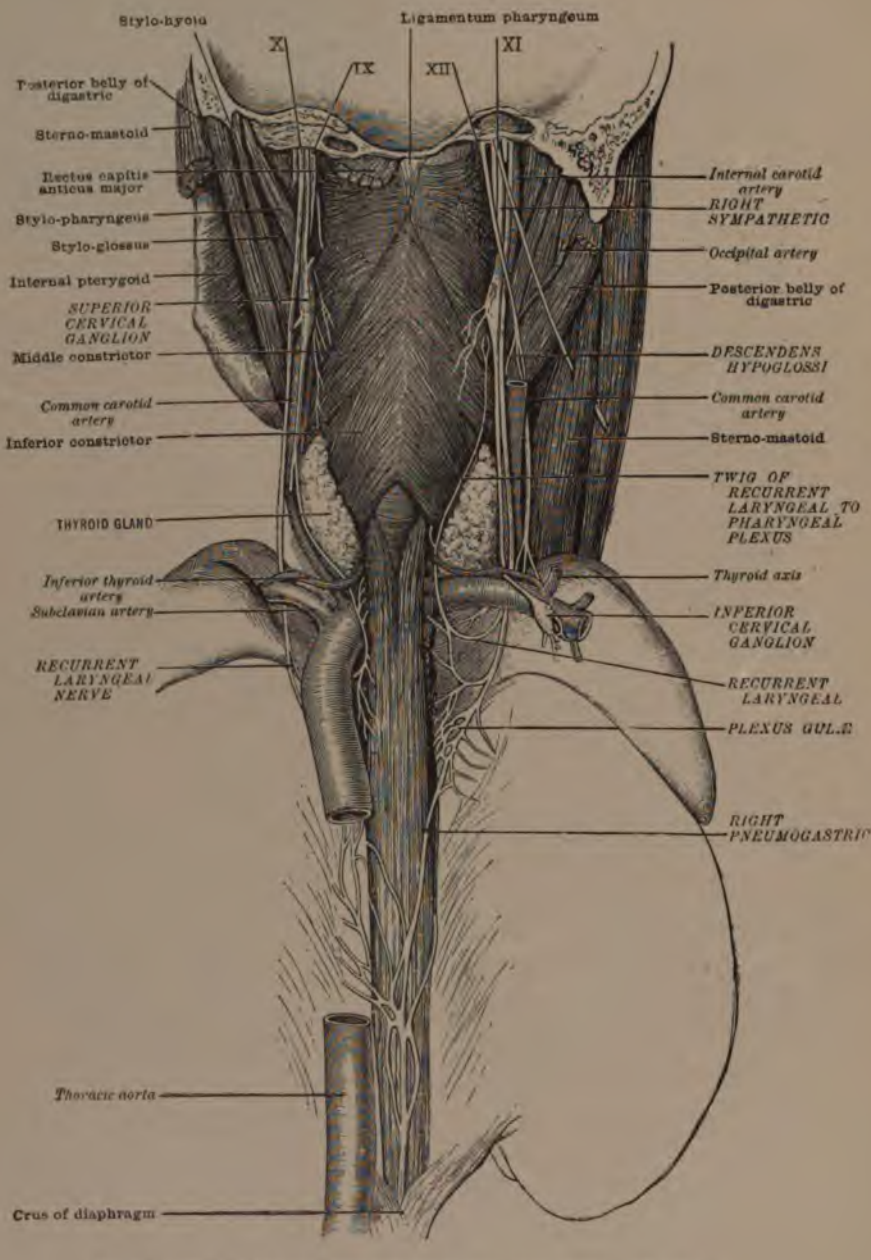


FIG. 436.—PHARYNX AND ADJOINING STRUCTURES SEEN FROM BEHIND. (MORRIS.)

STRUCTURE of the PHARYNX.

Presents three coats, which, from without inwards, are muscular, fibrous, mucous; and vessels & nerves.

MUSCULAR COAT — Is formed by:

Inferior Constrictor – Side of cricoid cartilage; oblique line on outer surface of ala of thyroid cartilage & surface behind it, and inferior cornu.
Raphé on posterior median line of pharynx; its inferior fibres being horizontal & continuous with those of œsophagus, and its superior fibres passing obliquely upwards and overlapping those of the middle constrictor. – S. by pharyngeal plexus and external & recurrent laryngeal nerves.

Middle Constrictor – Whole extent of upper surface of great cornu of hyoid bone, lesser cornu, stylo-hyoid ligament.
Raphé on posterior median line of pharynx; its inferior fibres descending beneath inferior constrictor, its middle fibres being horizontal, and its superior fibres overlapping superior constrictor & stylo-pharyngeus. – S. by pharyngeal plexus.

Superior Constrictor – Lower third of free margin of internal pterygoid plate, its hamular process, & contiguous part of palate bone; pterygo-maxillary ligament; alveolar process of inferior maxilla above mylo-hyoid ridge; side of tongue.
Raphé on posterior median line of pharynx; its superior fibres ascending by means of strong fibrous band below mentioned, to pharyngeal spine on basilar process, its lower fibres being horizontal. – S. by pharyngeal plexus.

F. 436

Stylo-pharyngeus – Inner side of base of styloid process.
With palato-pharyngeus into posterior border of thyroid cartilage & side of pharynx. – S. by pharyngeal plexus & glosso-pharyngeal nerve.

Palato-pharyngeus – Posterior surface of soft palate by two heads separated by levator palati.
With stylo-pharyngeus into posterior border of thyroid cartilage & side of pharynx. – S. by pharyngeal plexus.

Salpingo-pharyngeus (Santorini) – Small fasciculus from outer surface of cartilaginous portion of Eustachian tube to stylo-pharyngeus, with which it blends inferiorly. Is often wanting. (Tubo-Salpingeus)
Other accessory muscles, the petro-, spheno-, & occipito-pharyngei, are also described; but they are rarely met with.

Relations – The constrictors overlap each other from below upwards. The stylo-pharyngeus passes between superior & middle constrictors; the superior laryngeal nerve between the middle & inferior constrictors; the recurrent laryngeal nerve beneath the inferior. – (Vide also relations of pharynx in foregoing Tablet).

FIBROUS COAT, or PHARYNGEAL APONEUROSIS — Thick above, thin below. Attached to petrous portion of temporal bone, under surface of body of sphenoid, and, by means of a strong fibrous band (cranio-pharyngeal ligament, Thomson & Cleland), to pharyngeal spine on under surface of basilar process.

MUCOUS MEMBRANE — Thick on under surface of body of sphenoid; covered with columnar ciliated epithelium as low down as floor of nares, with squamous epithelium below. Beneath it are found numerous glands, which are simple & compound follicular and racemose.

VESSELS & NERVES — Arteries. Ascending pharyngeal, pterygo-palatine, superior or descending palatine, superior thyroid. – Veins. Open into the superior thyroid & internal jugular. – Lymphatics. Open into deep glands of neck. – Nerves. From pharyngeal plexus, and from external & recurrent laryngeal nerves.

THE SOFT PALATE.

Musculo-membranous fold, which forms an incomplete septum between the mouth and pharynx. Presents:

Anterior Surface – Concave; presents a median raphé, continuous with that of hard palate.

Posterior Surface – Convex, continuous with floor of nasal fossæ; presents the median projection of the azygos uvulæ.

Upper Border – Attached to posterior border of hard palate.

Lower Border – Free; presents the uvula and the anterior & posterior pillars, which two latter embrace the tonsil.

ANTERIOR PILLARS – Downwards & forwards to sides of base of tongue; contain palato-glossi muscles.

POSTERIOR PILLARS – Downwards & backwards to sides of pharynx; contain palato-pharyngei muscles Are rather broader and approach nearer to each other than the anterior.

ISTHMUS FAUCIUM – Is the space bounded by the free border & pillars of the soft palate, the tonsils, and the base of the tongue.

STRUCTURE of the SOFT PALATE

Presents for examination:

APONEUROSIS — Blended with tendon of tensor palati. Is thickest above, where it is attached to posterior border of hard palate.

MUSCLES — Five on each side:

Levator Palati – Under surface of apex of petrous portion of temporal bone and outer aspect of cartilaginous portion of Eustachian tube.
Posterior surface of soft palate between the two heads of origin of palato-pharyngeus. – S. by post. or small palatine branch from Meckell's g.

Spine of Sphenoid – Hill
Scaphoid Fossa – Valley
Vaginal process – Plain

Tensor or Circumflexus Palati – Scaphoid fossa at base of internal pterygoid plate; spine of sphenoid; anterior aspect of cartilaginous portion of Eustachian tube.
Winds round hamular process and expands upon anterior surface of aponeurosis of soft palate. – S. by a branch from otic ganglion.

Palato-glossus – Anterior surface of soft palate.
Posterior part of side of tongue, where it blends with stylo-glossus.

Palato-pharyngeus – Posterior surface of soft palate by two heads separated by the levator palati.
Posterior border of thyroid cartilage & sides of pharynx.

Azygos Uvulæ – Posterior nasal spine of palate bone & aponeurosis of soft palate.
Uvula. – S. by posterior or small palatine branch from Meckell's gangl.

MUCOUS MEMBRANE — Thin; covered with squamous epithelium, except near Eustachian tube, where the epithelium is columnar & ciliated. Numerous mucous glands are found beneath it, especially over posterior surface & uvula, in which latter situations they form a continuous layer.

VESSELS & NERVES — ARTERIES. Inferior or ascending palatine, posterior or descending palatine, ascending pharyngeal, dorsalis linguæ, tonsillar. – VEINS. Join the tonsillar & pterygoid plexuses. – LYMPHATICS. To glands beneath angle of jaw. – NERVES. From fifth, facial & glosso-pharyngeal.

SHORT POSTERIOR CRANIO-VERTEBRAL MUSCLES.

Rectus Capitis Posticus Major – Spinous process of axis.
Into and beneath outer part of inferior curved line of occipital bone.

Rectus Capitis Posticus Minor – Tubercle on posterior arch of atlas.
Into and beneath inner part of inferior curved line of occipital bone.

Obliquus Capitis Inferior – Spinous process of axis.
Extremity of transverse process of atlas.

Oblquus Capitis Superior – Extremity of transverse process of atlas.
Occipital bone between the two curved lines externally to the complexus a
rectus capitis posticus major.

These muscles are supplied by the posterior branch of the suboccipita
nerve; the inferior oblique is also supplied by the great occipita
nerve.

THE VERTEBRAL ARTERY

Fig 432 p 214 b

Arises from upper & back part of first portion of subclavian.
Upwards & backwards to foramen in transverse process of 6th cervical vertebra, passing beh
vasculo-nervous bundle of the neck and more particularly behind inferior thyroid artery
internal jugular vein, and then between scalenus anticus & longus co
Upwards through the series of foramina in the transverse processes as far as upper border of a
with the vertebral vein and a plexus of the sympathetic, the artery lying between the v
which is in front, and the cervical nerves which emerge behind from the intervertel
forami
Upwards & outwards to, and then through, foramen in transverse process of atlas.
Backwards & inwards behind lateral mass in groove on posterior arch of atlas, lying in the tri
gular space between the recti & obliqui muscles, and being crossed by the posterior bra
of the suboccipital nerve and covered by the comple
Pierces posterior occipito-atloid ligament, and enters the skull through the foramen magnum.
Winds round medulla oblongata between hypoglossal nerve and anterior root of suboccipi
ascends obliquely between anterior surface of medulla oblongata & basilar process,
joins its fellow opposite lower border of pons Varolii to form basilar tru

BRANCHES — Are cervical & cranial.

CERVICAL:

Muscular – Several, small, to the deep muscles of the neck.

Lateral Spinal – Through intervertebral foramina, and divide into:

Ant. Branch – To posterior surface of bodies of vertebræ;

Post. Branch – To roots of nerves, cord & its membranes.

CRANIAL:

Posterior Meningeal – Two or three, small, to dura mater of cerebellar fossa

Posterior & Anterior Spinal – Arise respectively behind upper part of c
and in front of medu

The two posterior descend behind the roots of the spinal nerves;

The two anterior unite into a single trunk, which descends along mi
line of c

Both join with, and are reinforced by, the numerous spinal branches deri
from the vertebral, ascending cervical, inferior thyroid, the intercos
lumbar, ilio-lumbar and lateral sacral; and are thus each of them c
tinued as small tortuous vessels, or rather as a series of inosculat
vessels, down to the extremity of the cord, where they resolve into tv
to cauda equ

Posterior Inferior Cerebellar – Backwards round medulla between pneu
gastric & spinal accessory nerves, and over restiform body to me
fissure or valley on under surface of cerebellum. Gives off an offse
under surface of cerebral hemisphere and twigs to choroid plexus of
ventri

Cerebellar artery –
2 (Superior ...
A P
... inferior) (Posterior ... ...)

FIGS. 436A & B.—MUSCLES OF THE PHARYNX. (A, Ellis; B, Sappey.)

In A:—A, B, C, inferior, middle, & superior constrictors; D, stylo-pharyngeus; F, H, levator & tensor palati; I, buccinator; K, hyoglossus; 1, 2, glosso-pharyngeal & hypoglossal nerves; 3, 4, 5, superior, external, and inferior or recurrent laryngeal nerves.

In B:—1 to 4, superior constrictor, showing its origin from 2, the inner plate of the pterygoid process, 3, the pterygo-maxillary ligament; 5 to 8, middle constrictor; 9 to 12, inferior constrictor; 13, 13, stylo-pharyngeus; 15, 16, stylo- and hyo-glossi; 17, mylo-hyoid; 18, buccinator pierced by Steno's duct; 19, 20, tensor & levator palati; 21, crico-thyroid.

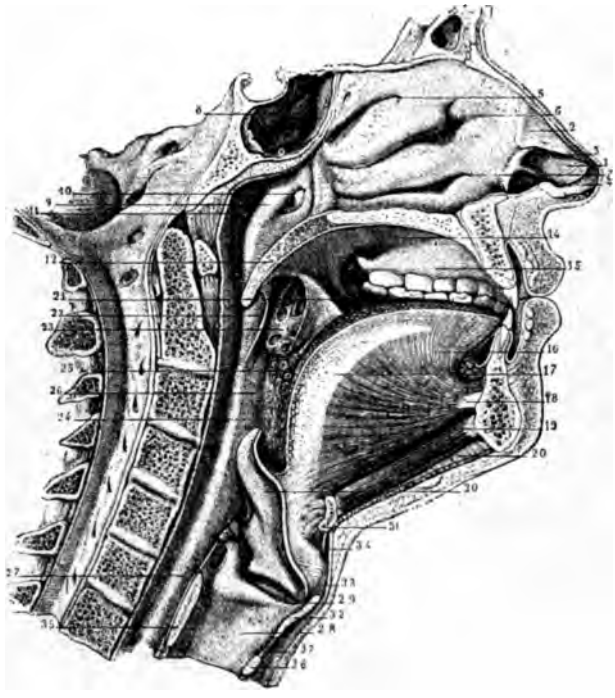


FIG. 436.—SAGITTAL SECTION THROUGH PHARYNX AND SURROUNDING PARTS. (Sappey.)

1, 2, 3, 4, anterior aperture, and superior and inferior lateral cartilages of nose; 5, 6, 7, superior turbinated process and meatus, middle turbinated process and meatus, inferior turbinated process and meatus; 8, sphenoidal sinus; 9, 11, posterior nares; 10, opening of Eustachian tube; 12, soft palate; 14, 15, hard palate; 16, 17, tongue with its median fibrous septum; 18, 19, 20, genio-hyo-glossus, genio-hyoid, and mylo-hyoid muscles, the latter in section; 21, 22, 23, anterior and posterior pillars of soft palate, and tonsil; 24, 25, 26, 27, pharynx and glands of base of tongue; 28, 29, 30, cavity and ventricle of larynx, and epiglottis; 31 to 37, sections of hyoid bone, thyroid cartilage, thyro-hyoid membrane, back and front parts of cricoid cartilage, and crico-thryoid membrane.

FIG. 437.—ARTICULATION BETWEEN ODONTOID PROCESS AND ATLAS. (Gray.)

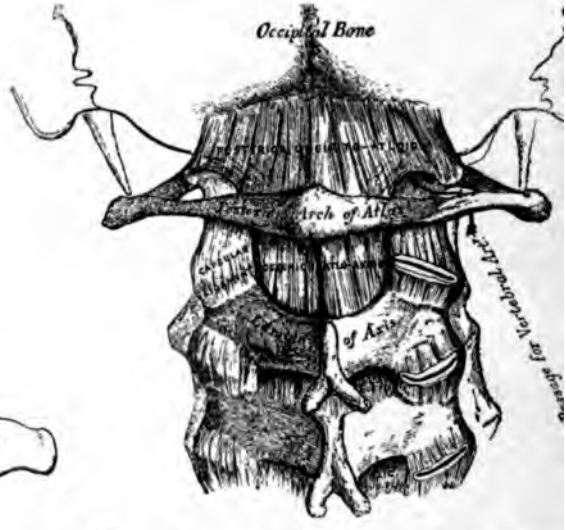


FIG. 438.—OCCIPITO-ATLOID AND ATLO-AXOID LIGAMENTS, POSTE VIEW. (Gray.)

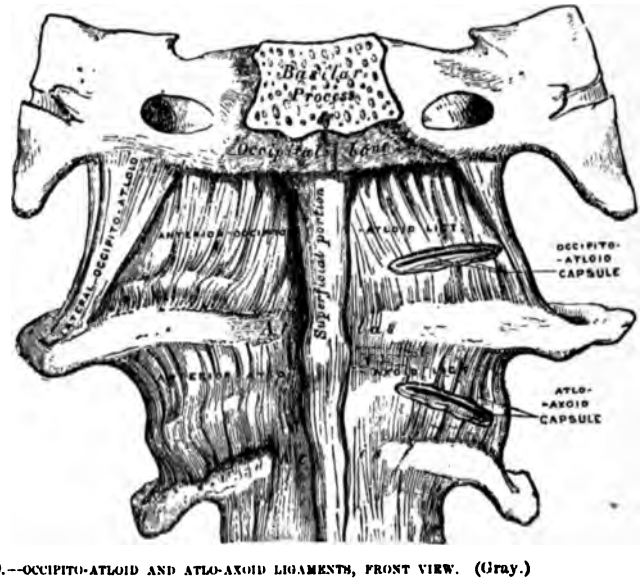


FIG. 439.—OCCIPITO-ATLOID AND ATLO-AXOID LIGAMENTS, FRONT VIEW. (Gray.)

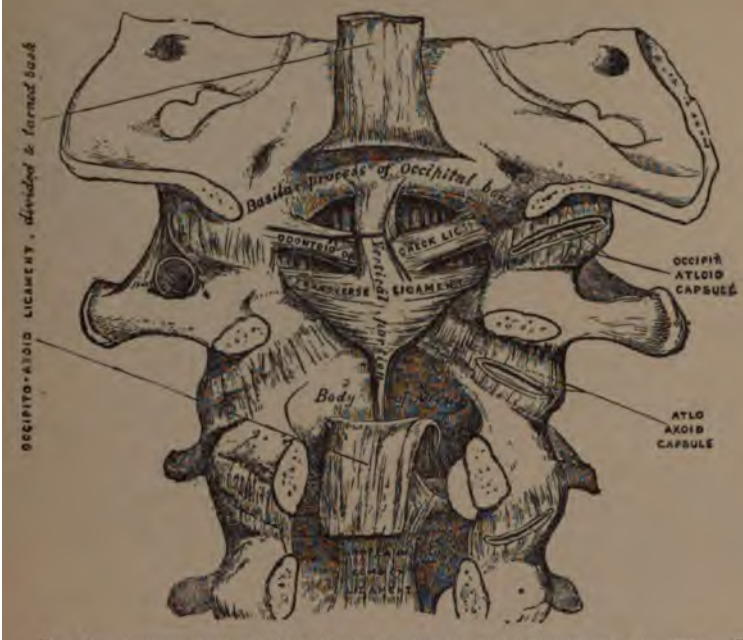


FIG. 440.—OCCIPITO-AXOID AND ATLO-AXOID LIGAMENTS AS SEEN FROM INTERIOR OF SPINE. (Gray.)

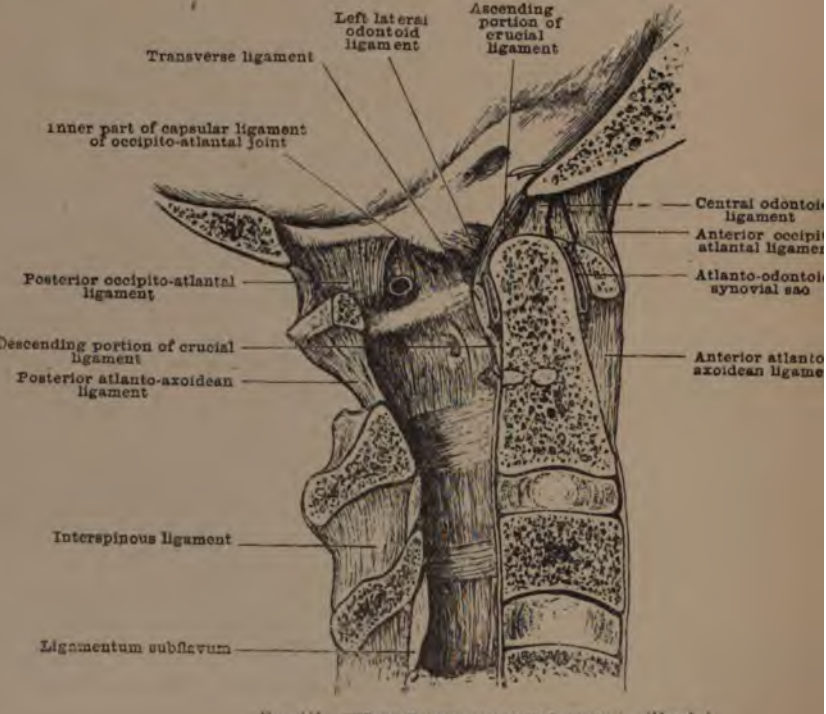


FIG. 441.—THE SAME SEEN IN SAGITTAL SECTION. (Morris.)

THE TWO FIRST SPINAL NERVES.

POSTERIOR DIVISION OF

First Cervical Nerve (Suboccipital) – Larger than anterior. Emerges between occipital bone & posterior arch of atlas just behind vertebral artery, enters triangle formed by small posterior cranio-vertebral muscles, supplies these muscles & complexus, and joins with posterior division of 2nd cervical nerve. Sometimes gives off a small cutaneous branch, which branch, when it exists, accompanies occipital artery to integument of lower & back part of occiput, and joins with great & small occipital

Second Cervical Nerve – Three or four times as large as anterior division, and the largest of the posterior cervical nerves. Emerges between posterior arch of atlas & lamina of axis, supplies inferior oblique, and after joining with posterior division of 1st & 3rd cervical nerves, divides into:

EXTERNAL BRANCH – Similar to external branches of six lower posterior cervical nerves, but somewhat larger, joins with corresponding branch of 3rd posterior cervical nerve, and supplies the same muscles, & also the complexus.

INTERNAL BRANCH (GREAT OCCIPITAL NERVE) – Crosses triangle formed by posterior cranio-vertebral muscles, pierces complexus & trapezius, joins with small occipital & with ascending twig from internal branch of posterior division of 3rd, and supplies integument of back of head as far as vertex; gives off an auricular branch to back of ear.

ANTERIOR DIVISION OF

First Cervical Nerve (Suboccipital) – Small. Emerges between occipital bone & posterior arch of atlas below vertebral artery. Passes forwards on inner side of vertebral artery & rectus lateralis muscle, crosses foramen in transverse process of atlas, and descends in front of this process to join with ascending branch of the second. Supplies the rectus lateralis & the recti capitis antici major & minor, and communicates with the pneumogastric, hypoglossal, & superior cervical ganglion of sympathetic

Second Cervical Nerve – Larger than foregoing, but still much smaller than the posterior division of the same nerve. Emerges between posterior arch of atlas & lamina of axis, passes forwards between transverse processes of the same vertebræ on outer side of vertebral artery, and divides into an ascending branch, which joins the first nerve, and a descending branch, which joins the second. Gives off the small occipital nerve

ARTICULATIONS of the CRANIUM with the SPINE

Are the *occipito-atloid* and *occipito-axoid* articulations, from which articulations the *atlo-axoid* articulation cannot well be separated.

OCCIPITO-ATLOID ARTICULATION — Consists of a double arthrodia between condyles of occipital and superior articular surfaces of atlas; the condyles being convex from before backwards & inwards and looking downwards & outwards, and the articular surfaces of the atlas being concave from before backwards & inwards and looking upwards & inwards. The ligaments are: –

Capsular – Two. Thin & loose; surround the arthrodial articulations. The synovial membranes of these articulations often communicate with that of the syndesmo-odontoid articulation.

Ant. Occipito-Atloid – Two:

SUPERFICIAL – Strong rounded cord from
Basilar process to – *Anterior tubercle of atlas.*

DEEP – Thin & broad membrane from
Anterior margin of foramen magnum to – *Upper border of anterior arch of atlas.*

Post. Occipito-Atloid – Thin & broad membrane from
Posterior margin of foramen magnum to – *Upper border of posterior arch of atlas.*
It is perforated on either side by vertebral artery & suboccipital n.

Lateral Occipito-Atloid – Two. Strong bands from
Jugular process to – *Base of transverse process of atlas.*

OCCIPITO-AXOID ARTICULATION — No direct contact between the two bones, but the two bones are firmly connected together, nevertheless, by the following ligts: –

Occipito-Axoid – Strong broad band expanded superiorly, and which may be considered as a continuation upwards of the posterior common ligament of the bodies of the vertebræ; from
Basilar groove of occipital, where it becomes continuous with dura mater of skull, to – *Posterior surface of body of axis.* – It covers and conceals the cruciform ligament.

Occipito-Odontoid – Three, two lateral & one median.

LATERAL OCCIPITO-ODONTOID OR CHECK LIGAMENTS – Strong rounded cords from
Rough depression on inner side of condyles of occipital to – *Sides of odontoid pr. near its apex.*

MEDIAN OR SUSPENSORY OCCIPITO-ODONTOID LIGAMENT – Strong band from
Anterior margin of foramen magnum to – *Apex of odontoid process.* – This band is situated between, & blended superiorly, with deep anterior occipito-atloid ligt., on the one hand, & upper fasciculus of cruciform ligt. on the other.

VERTICAL FASCICULUS OF CRUCIFORM LIGT. – V. below.

ATLO-AXOID ARTICULATION — Is a complex articulation consisting: 1. of a double arthrodia between the articular processes, the articular surfaces of which are large, flat, circular, and inclined downwards & outwards. 2. of a double diarthrosis rotatorius between the anterior & posterior surfaces of the odontoid process, on the one hand, and the posterior & anterior surfaces respectively of the anterior arch of the atlas & of the transverse ligament, on the other hand, (atlo-odontoid & syndesmo-odontoid articulations, Cruveilhier). The ligaments are: –

Capsular – Two. Thin, loose, strongest externally; surround the two arthrodiæ.

Ant. Atlo-Axoid – Two:

SUPERFICIAL – Strong rounded cord from
Anterior tubercle of atlas to – *Base of odontoid process & front of body of axis.*

DEEP – Thin & broad membrane from
Lower border of anterior arch of atlas to – *Base of odontoid process & front of body of axis.*

Post. Atlo-Axoid – Thin & broad membrane from
Lower border of posterior arch of atlas to – *Upper border of lamina of axis.*

Transverse – Strong transverse band, broadest in middle, which divides ring of atlas into a small anterior part, in which anterior part the neck of the odontoid process is firmly constricted, and a much larger posterior part, which transmits the cord & its membranes & the spinal accessory nerves. It is attached on each side to a
Tubercle on inner surface of lateral mass of atlas – Its anterior surface is lined with synovial membrane of syndesmo-odontoid articulation. From its upper & lower borders, or rather from its posterior surface, are given off two fasciculi, which pass upwards & downwards to be attached, the one to the *basilar groove,* the other to *posterior surface of body of axis;* with the transverse band, these vertical fasciculi form the *cruciform ligament.*
The synovial membrane of the syndesmo-odontoid articulation often communicates with one or both of those of the occipito-atloid arthrodiæ.

HEAD & NECK.

VIII.

NASAL FOSSÆ, AND DEEP VESSELS & NERVES OF NECK.

THE NASAL FOSSÆ.

Two narrow irregular cavities comprised between the orbits & superior maxillary bones, and between the roof of the mouth & the front part of the base of the skull.
Formed by ethmoid, sphenoid, frontal, superior maxillary, nasal, palate, inferior turbinated & vomer (all the bones of the face except malar & inferior maxillary).
Communicate with orbit (nasal duct), mouth, (anterior palatine canal), cranium (olfactory foramina), spheno-maxillary fossa (spheno-palatine foramen), and with the frontal, ethmoidal, sphenoidal, & maxillary sinuses. – Present

ROOF — Narrow, and is from before backwards:
Oblique upwards & backwards and formed by nasal bone & nasal spine of frontal,
Horizontal and formed by cribriform plate of ethmoid,
Oblique downwards & backwards and formed by body of sphenoid. – Presents the sutures between the foregoing bones and from before backwards
Groove on nasal bone for outer branch of nasal nerve;
Half crest for perpendicular plate of ethmoid;
Olfactory foramina & nasal slit for olfactory and nasal nerves;
Openings of sphenoidal sinuses partly closed by sphenoidal turbinated bones;
Articulation of alæ of vomer with body of sphenoid.

FLOOR — Concave from side to side, and formed by palate processes of superior maxillary & palate bones. – Presents the suture between foregoing bones & the
Upper orifice of the anterior palatine canal;
Half crest for vomer, which terminates in front & behind in the
Anterior & posterior nasal spines.

INNER WALL — Formed principally by the perpendicular plate of the ethmoid above & in front, and by the vomer below & behind, and secondarily by nasal spine of the frontal, rostrum of sphenoid, crests of superior maxillary, nasal & palate bones. Has an angular deficiency in front which is filled up by the cartilage of the septum. – Is frequently inclined to one or other side; and presents the sutures between the foregoing bones and
Vascular & nervous furrows &
Naso-palatine groove for naso-palatine nerve.

OUTER WALL — Formed by:
Lacrymal bone & nasal process of superior maxillary;
Inner surface of ethmoid, superior maxillary & inferior turbinated bones;
Vertical plate of palate bone & inner plate of pterygoid process. – Presents the sutures between the foregoing bones and from above downwards
Superior turbinated process of ethmoid;
Superior meatus, into which open the sphenoidal & posterior ethmoidal sinuses and the spheno-palatine foramen. – Both are short and are situated at the posterior and upper part of the nares
Middle turbinated process of ethmoid;
Middle meatus, larger than foregoing, into which open the Antrum of Highmore and through the infundibulum, the anterior ethmoidal cells & frontal sinuses;
Inferior turbinated bone;
Inferior meatus, the largest, presents in front the opening of the nasal duct.

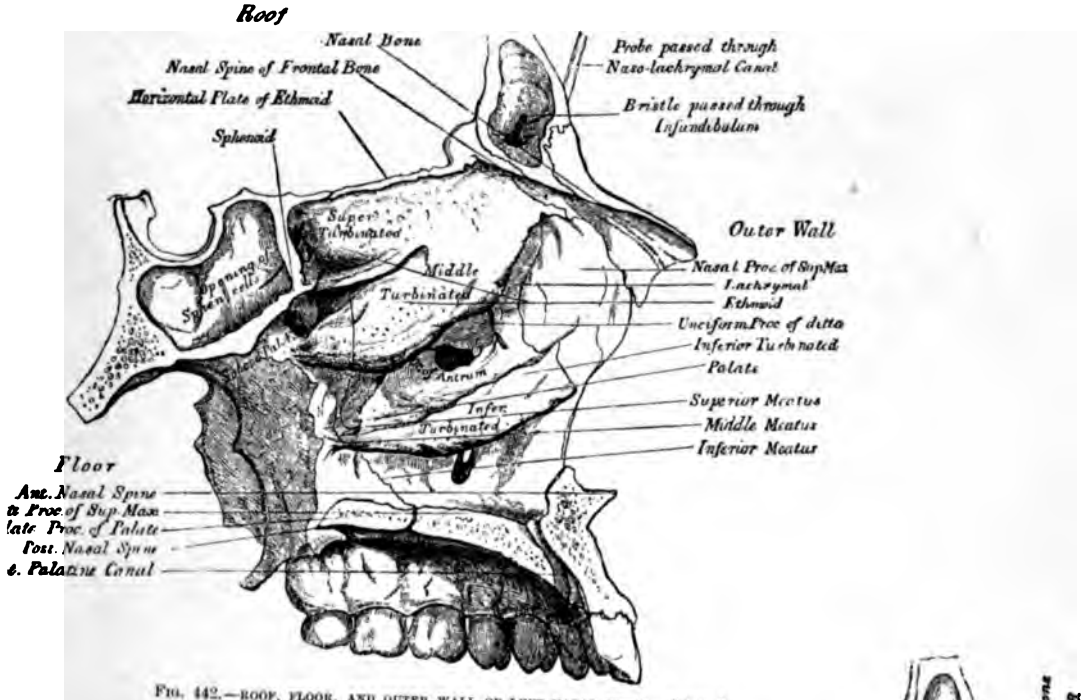


FIG. 442.—ROOF, FLOOR, AND OUTER WALL OF LEFT NASAL FOSSA. (Gray.)

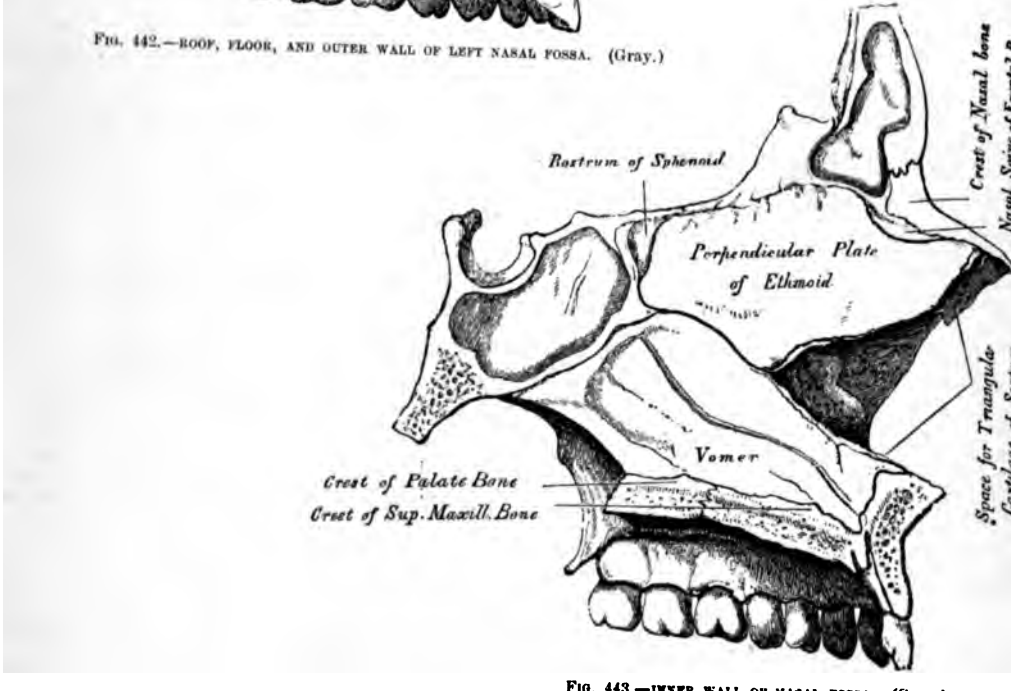
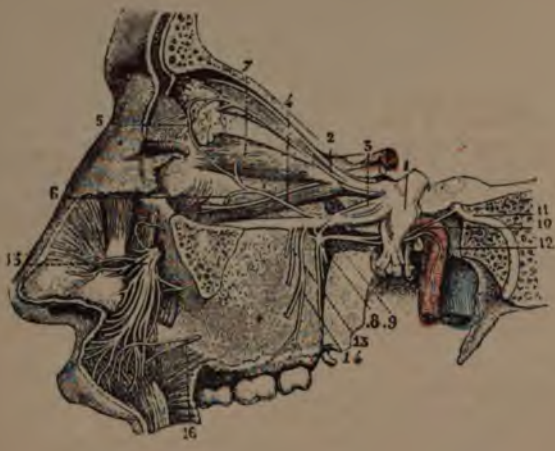

Rostrum of Sphenoid
Crest of Nasal bone
Nasal Spine of Frontal B.
Perpendicular Plate of Ethmoid
Vomer
Crest of Palate Bone
Crest of Sup. Maxill. Bone
Space for Triangular Cartilage of Septum

FIG. 443.—INNER WALL OF NASAL FOSSA. (Gray.)



FIGS. 444.—SUPERIOR MAXILLARY NERVE AND MECKEL'S GANGLION, FROM THE OUTER SIDE.

1, Gasserian ganglion; 3, superior maxillary nerve; 13, 14, superficial posterior dental branches; 4, orbital branch; 9, Vidian nerve; 10, its motor root; 12, its sympathetic root. (See expl., p. 228l.)

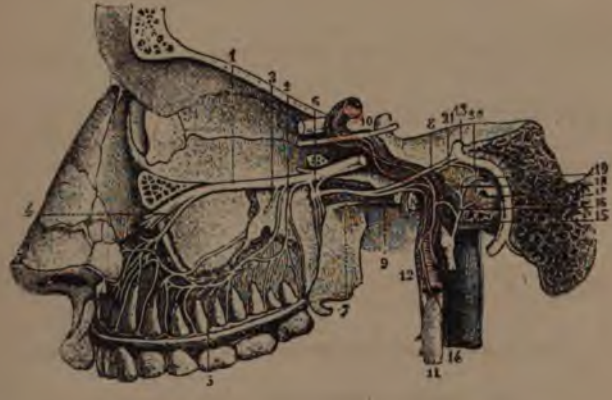


FIG. 445.—SUPERIOR MAXILLARY NERVE AND MECKEL'S GANGLION, FROM THE OUTER SIDE.

2, deep posterior dental nerve; 4, anterior dental nerve; 6, Meckel's ganglion; 7, Vidian nerve. (See expl., p. 228m.)

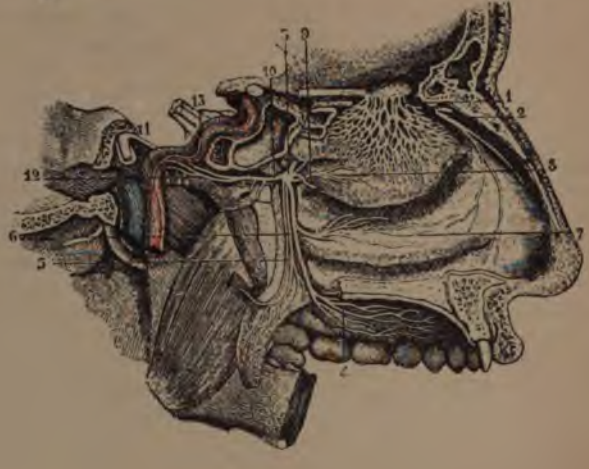


FIG. 446.—MECKEL'S GANGLION, SEEN FROM INNER SIDE, AND NERVES TO THE NOSE.

3, Meckel's ganglion; 4, anterior or great palatine nerve; 5 & 6, small and external palatine nerves; 8, superior nasal nerve; 9, naso-palatine nerve, divided; 10, Vidian nerve. (See expl., p. 228m.)

'IRST or OLFACTORY NERVE

(Dissectional description; see new description, page 228c)

Arises by three roots.

THE THREE ROOTS — Are the:

External or Long Root—Arises from the *posterior boundary of the fissure of Sylvius.* It passes forwards and inwards along the anterior margin of the locus perforatus anticus.

Internal or Short Root—Arises from the *posterior and inner part of the frontal lobe.* It passes forwards & outwards, and joins the foregoing root just above the origin of the middle or grey root.

Middle or Grey Root—Begins in a pyramidal eminence, the *caruncula mammillaris*, of the grey matter of the posterior part of the frontal lobe, and is continued upon the upper surface of the nerve with a few white fibres derived from the corpus striatum.

The three roots coalesce and form a prismoid band, the

OLFACTORY PROCESS, — which passes forwards in a deep sulcus along the side of longitudinal fissure, and expands into the

OLFACTORY BULB, — from the under surface of which are given off about twenty

TERMINAL BRS., — which pass through the foramina in the cribriform plate of the ethmoid, and — forming *three sets* distributed respectively over the *roof of the nose*, over the *upper third of the septum*, and over the *superior & middle turbinated bones* — proceed between the fibrous & mucous layers of the Schneiderian membrane, ramify and unite and form a plexus with narrow elongated meshes, and probably terminate in the deep processes of the olfactory cells of Schultze.

These latter cells are spindle-shaped nucleated bodies, which stand vertically in great numbers among the columnar epithelial cells of the olfactory region; their extremities are continued into two thread-like processes, one of which terminates abruptly on a level with the free extremities of the epithelial cells, while the other passes downwards towards the attached surface of the mucous membrane.

The olfactory nerve contains a *large proportion of the grey matter*, and is soft and pulpy. Its filaments are deficient in the white substance of Schwann, and are granular and nucleated like the gelatinous nerve-fibres of Remak.

SUPERIOR MAXILLARY NERVE.

Intermediate in size between ophthalmic & inferior maxillary nerves. – Commences a middle of Gasserian ganglion

Through foramen rotundum, spheno-maxillary fossa & infraorbital canal to infraorbita foramen, and divides beneath levator labii superioris into *palpebral, nasal & labia branches*, which branches anastomose with facial nerve forming infraorbital plexu and supply muscles, skin & mucous membrane

BRANCHES:

Orbital or Temporo-malar Br. – Into orbit through spheno-maxillary fissure and divides into

TEMPORAL BR. – In groove & through foramen in malar bone, joining witl lachrymal

Pierces temporal muscle & fascia to skin of temple, and joins witl facial & auriculo-temporal

MALAR BR. – Through foramen in malar bone to skin of prominent part o cheek

Spheno-palatine Brs. – Two. To Meckel's ganglion, of which they form th sensory root

Post. Dental Brs. – Two:

ANTERIOR OR SUPERFICIAL – Over maxillary tuberosity to gums & buccinator

POSTERIOR OR DEEP – Forwards in outer wall of Antrum, joining anterio dental nerve, and supplies molar & second bicuspid teeth & mucou membrane of Antrum

Ant. Dental Br. – Arises just before exit of superior maxillary nerve from infra orbital canal

Downwards & forwards in anterior wall of Antrum joining with posterio dental nerve, and supplies incisor, canine & first bicuspid teeth an mucous membrane of inferior meatus. A twig joins superior nasa branch of Meckel's ganglion above eye-tooth, and presents a smal ganglion, the ganglion of Bochdalek

SPHENO-PALATINE or MECKEL'S GANGLION.

Triangular, of a reddish grey colour and situated in spheno-maxillary fossa near spheno palatine foramen, mainly behind spheno-palatine branches of superior maxillary nerve the fibres of these branches not being, or being but partly, involved in the ganglion a they descend to the nose & palate. Presents

THREE ROOTS:

Sensory Root — From superior maxillary nerve through its two spheno palatine branches

Motor Root — From facial nerve through Vidian nerve.

Sympathetic Root — From carotid plexus also through Vidian nerve.

BRS. OF DISTRIBUTION — Are divided into:

Ascending Brs. — Two or three small filaments, which pass up through spheno maxillary fissure to periosteum of orbit

Descending Brs. — Are the:

ANT. OR GREAT PALATINE N. - Through great posterior palatine canal giving off inferior nasal branches to middle meatus & to middl & inferior turbinated bones, and a twig to soft palate Forwards in groove on hard palate, and joins termination of naso-palatin nerve

EXT. PALATINE N. - Through external palatine canal to tonsil & soft palate Is sometimes wanting

POST. OR SMALL PALATINE N. - Through small posterior palatine canal t tonsil, soft palate and levator palati & azygos uvulæ

Internal Brs. — Are the:

SUP. NASAL BR. - Small. Through spheno-palatine foramen to mucous mem brane of superior & middle spongy bones & upper & back part o septum. A twig joins anterior dental nerve in outer wall o antrum of Highmore above eye-tooth & presents a small ganglion the ganglion of Bochdalek

NASO-PALATINE BR. - Through spheno-palatine foramen & across roof o nose to septum, and downwards to anterior palatine foramen Through central division of the anterior palatine foramen, or foramer of Scarpa, right nerve being posterior to left one Joins its fellow in common anterior palatine canal and ends in mu cous membrane of hard palate, joining with anterior or great palatine nerve

Posterior Brs. — Are the:

VIDIAN N. - Backwards through Vidian canal (if the nerve be traced from Meckel's ganglion), giving twigs to back of roof & septum of nos and to termination of Eustachian tube, and divides into

LARGE PETROSAL N. - Through cartilaginous substance of foramen lace rum medium, and then in groove on anterior surface of petrou portion of temporal bone beneath Gasserian ganglion & through hiatus Fallopii to geniculate ganglion or intumescentia gangli formis of facial

CAROTID BR. - Soft and of reddish grey colour. Through cartilaginou substance to carotid plexus on outer side of internal carotid artery

PHARYNGEAL OR PTERYGO-PALATINE N. - Small. Through pterygo palatine canal to mucous membrane of upper part of pharynx.

INFERIOR MAXILLARY NERVE.

The largest of the three divisions. Both sensory & motor, its two roots uniting immediat
after their exit from foramen ov

Divides a few lines below base of skull into:

ANTERIOR or SMALLER DIVISION — Principally motor. Divides into:

Masseteric Br. – Outwards above external pterygoid muscle and through sigm
notch to masseter. Gives off a twig to temporo-maxillary articulation & so
times one to temporal mus

Deep Temporal Brs. – Two, anterior & posterior. Outwards above external pte
goid muscle and reflected upwards at pterygoid ridge to temporal muscle.
sometimes joined, anterior one with buccal nerve, posterior one with massete

Buccal Br. – Pierces external pterygoid, and forwards on buccinator, giving filame
to temporal muscle, integument & mucous membrs

Pterygoid Brs. – Two, to internal & external pterygoid muscles. Branch to inter
pterygoid gives off motor root to otic ganglion. Branch to external pterygoi
frequently derived from buc

POSTERIOR or LARGER DIVISION — Sensory with a few motor fibres. Divi
in

Auriculo-temporal N. – Has generally two roots which embrace middle mening
artery. Backwards beneath external pterygoid & neck of condy
Upwards with temporal artery between condyle & external ear under cover
parotid gland, and divides in

AURICULAR BRS. – Inferior & superior, to outer surface of pinna, jc
ing with great auricu

TEMPORAL BRS. – Anterior & posterior; with branches of tempc
artery to skin of temporal region & ver

Joins facial nerve behind neck of condyle usually by two branches; gi
off sensory root of otic ganglion and filaments to parotid glan
temporo-maxillary articulati

Gustatory or Lingual N. – Between the two pterygoid muscles, where it lies
inner side & in front of inferior dental nerve, and is joined by chorda tympa
Above deep portion of submaxillary gland & along side of tongue, crossing Wh
ton's d
Supplies mucous membrane of mouth & gums, submucous glands, conical & f
giform papillæ and mucous membrane of tong
Gives sensory branches to submaxillary ganglion, and anastomoses with hy
glossal nerve on anterior margin of hyo-glossus & near tip of tong

Inf. Dental N. – Between the two pterygoid muscles, where lies behind & on ou
side of gustato
Between ramus & internal lateral ligament of temporo-maxillary articulation
dental foramen, where gives off nerve to mylo-hyoid mus
Along inferior dental canal, giving branches to molar & bicuspid teeth, & di
des at mental foramen in

INCISOR BR. – Onwards in dental canal to canine & incisor teeth.

MENTAL BR. – Divides beneath depressor anguli oris into numer
branches to muscles, skin & mucous membrane of lower

NERVE TO MYLO-HYOID – Along groove on inner surface of ramus
under surface of mylo-hyoid & anterior belly of digast

N. — All the terminal branches of the 5th nerve upon the fa
join with facial ner

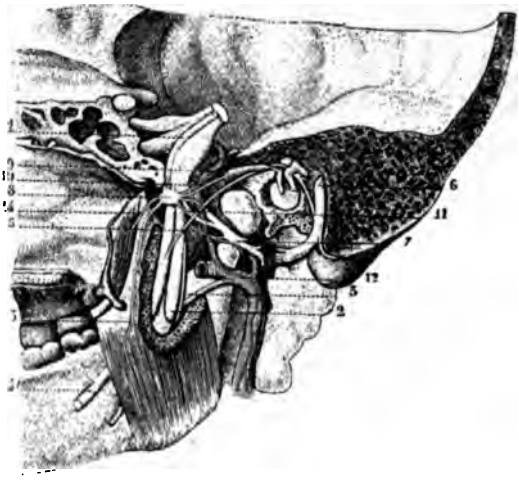


Fig. 447. THE OTIC GANGLION FROM THE INNER SIDE. (See expl., p. 228m.)

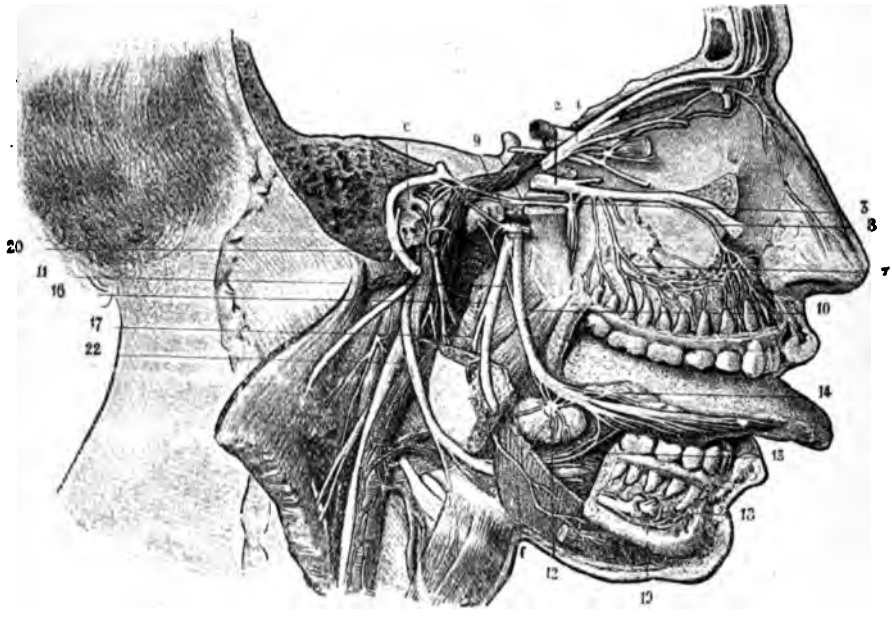


Fig. 448. THE OTIC GANGLION FROM THE OUTER SIDE; THE DEEPER NERVES OF THE HEAD AND NECK. (See expl., p. 228m.)

FIG. 449.—THE DEEP ARTERIES OF THE HEAD AND NECK. (Gray.)

OTIC GANGLION.

Small oval shaped flattened body of a reddish grey colour situated on inner surface
inferior maxillary nerve & around origin of its internal pterygoid branch, just belc
foramen ovale, close to tensor tympani muscle & cartilaginous portion of Eust
chian tube which lie on its inner side, and to middle meningeal artery which li
behind. It present

THREE ROOTS:

Sensory Root - From auriculo-temporal nerve, and also from gloss
pharyngeal through small petrosal nerv

Motor Root - From inferior maxillary nerve & its internal pterygoid branch
also from facial nerve through small petrosa

Sympathetic Root - From plexus on middle meningeal artery.

BRS. OF DISTRIBUTION — Small branches to tensor palati & tensor tympani.

INTERNAL CAROTID ARTERY.

Commences at bifurcation of common carotid opposite upper border of thyroid cartilage & the so-called superior carotid triangle. It is at first very superficial, being covered o by thin anterior border of sterno-mastoid, platysma & fascia, and lying on outer side & rather behind, external carotid arte

May be divided into cervical, petrous, cavernous & cerebral portions.

CERVICAL PORTION — Ascends vertically to carotid foramen, passing (as does a external carot

BENEATH – Digastric & stylo-hyoid muscles, occipital artery, hypoglossal nerve parotid gland, – then ascending beneath, and being separa from external carotid

Stylo-glossus & -pharyngeus & the styloid process, the glosso-phar geal nerve and sometimes the pharyngeal branch of the vagt Its deep relations a

ON INNER SIDE – Pharynx, tonsil, ascending pharyngeal art., superior laryngea

BEHIND – Rectus capitis anticus major & transverse processes of the three up cervical vertebræ; – superior cervical ganglion & main tr of sympathetic, and superior laryngeal ner

BEHIND & EXTERNALLY – Internal jugular vein, and, lying between & behind two vessels, the pneumogastric ner

Usually gives off no branches.

PETROUS PORTION — Ascends in carotid canal in front of tympanum, being surroun by carotid & cavernous plexuses, and then curves forwards & inwards. – Send sn

Tympanic Branch – To tympanum through a minute foramen in terior wall of carotid ca

CAVERNOUS PORTION — Ascends to sphenoid bone, and then runs forwards in ca nous groove, lying in inner wall of cavernous sinus, by lining membrane of whic is covered, and being, on its outer side, crossed by 6th nerve and more distal related to 3rd, 4th, & ophthalmic branch of the

Gives off:

Ophthalmic Artery – Vide p. 209.

Arteriæ Receptaculi – Several, small, to walls of cavernous sin dura ma

CEREBRAL PORTION — Ascends between optic nerve & anterior clinoid process, pe rates dura mater of roof of sinus, receives sheath from arachnoid, and after giving

Post. Communicating & Ant. Choroid, divides opposite in extremity of fissure of Sylvius i

Ant. & Middle Cerebral – Vide next Tablet.

Ant. Choroid Artery – Arises from internal carotid, or sometimes f middle cereb

Backwards through lateral part of transverse fissure of brain to desc ding cornu of lateral ventricle, and supplies choroid ple

Added, 1897.

NOTES ON THE NEWER MATTER.

Sömmering's Classification of the Cranial Nerves.

Following the Continental custom, British anatomists now frequently reckon separately the two nerves of the 7th pair of Willis's classification, and the three nerves of the 8th pair. This gives twelve pairs of cranial nerves, which are *re*numbered *from the 8th onwards* as follows :—

8th	...	...	..	...	Auditory.
9th	...	...	...	...	Glosso-pharyngeal.
10th	...	...	...	...	Pneumogastric.
11th	...	...	...	..	Spinal accessory.
12th	...	...	...	...	Hypoglossal.

This is the classification of Sömmering, based upon the succession from before backwards of the *apparent origins*. The classification of Willis was based upon the succession of the *foramina of the base of the skull* through which the several nerves leave the cranium. In this latter classification, facial & auditory, as they leave the cranium through the same foramen, counted as one nerve; and so did, for the same reason, the glosso-pharyngeal, pneumogastric, & spinal accessory. A third classification is being worked out by degrees, based on the succession of the *real origins*.

Cervical Plexus & the Hypoglossal Nerve.

A paragraph of some interest must now be detached from the description of the hypoglossal nerve, and transferred to that of the cervical plexus. The distribution of

the hypoglossal nerve now appears to be limited to the muscles of the tongue, – the branches which this nerve *seems* to give off to the infra-hyoid muscles, and to the thyro-hyoid and genio-hyoid, being really derived from the loops between the first & second and second & third cervical nerves

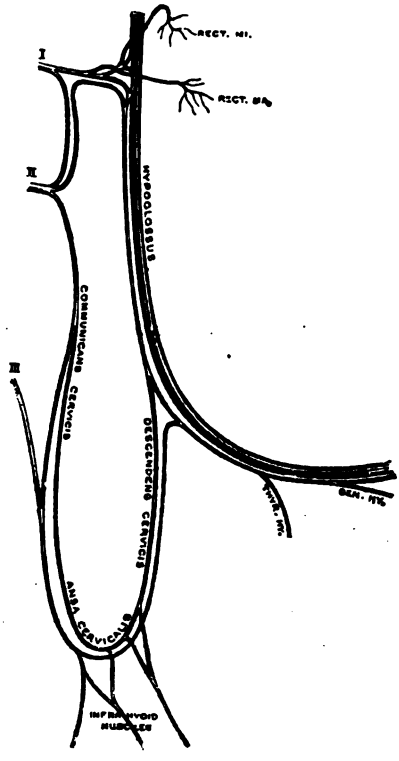


FIG. 449A.—PLAN OF THE BRANCHES APPARENTLY GIVEN OFF BY THE HYPOGLOSSAL NERVE, BUT REALLY DERIVED FROM THE CERVICAL PLEXUS. (*Quain, after Holl.*)

Filaments from the loop between the *first and second cervical nerves* (ansa atlantis) join the outer aspect of the hypoglossal nerve, and appear to become incorporated with it. A portion of these pass up in the trunk of the nerve to supply the recti capitis antici major and minor, and to run, perhaps, in the recurrent branch to the dura mater. Other filaments descend till, having reached the level where the hypoglossal nerve loops round the occipital artery, some of them leave the trunk to form part of the descendens and ansa hypoglossi, while others pass on a little further, as further explained, to the thyro-hyoid and genio-hyoid.

From the loop between the *second and third cervical nerves* there descends, either the communicans cervicis, or two smaller branches, more or less conjoined, the *communicans*

cervicis and the *communicans cervicis accessorius*. These also have a double distribution: (1) some of their filaments join the descendens cervicis to form part of the *ansa hypoglossi*, from which branches are given off to the sterno-hyoid & -thyroid, and to both bellies of the omo-hyoid, – an additional small filament sometimes joining the phrenic nerve; while (2) other filaments rejoin those filaments from the ansa atlantis which did *not* leave the hypoglossal nerve to form part of the descendens hypoglossi. The thus reunited filaments from the two cervical sources above named run a little further on in the trunk of the hypoglossal nerve, which they finally leave on the surface of the hyo-glossus muscle to supply the thyro-hyoid & genio-hyoid.

A filament of the descendens hypoglossi is believed to pass down into the thorax in front of the large vessels, to join with the cardiac and phrenic nerves.

It must be plain that, for our former *dissectional* basis of Anatomy, which gave us a personal, true, and practical knowledge of Anatomy, and made us surgeons, we are substituting by degrees a basis which, as far as the mass of the students, and of the profession, are concerned, is one of mere hearsay, – vague, uncertain, and useless in regard to making us practical men.

Olfactory Nerves.

Traced towards the brain, the inner root of the olfactory tract is seen to run along the inner boundary of the anterior perforated space to join the convolution of the corpus callosum; the outer root runs along the outer boundary of the same space, where

Fig. 449B.—Diagram of the limbic lobe. (Quain.)
The roots of the olfactory nerve are shown at the lower and front part of the figure.

it is lost in man; in animals with an acute sense of smell it may be traced into the uncus of the hippocampal convolution. The middle root enters the corpus striatum and joins the anterior commissure. (See note on the Olfactory bulb in the Development of the Brain, page 284a.)

It is not correct morphologically to speak of the "olfactory nerve" in the older sense; it should be "olfactory nerves," and the term should be restricted to the filaments

arising from the under surface of the olfactory bulb. These are about twenty in number, and pass through the foramina of the cribriform plate of the ethmoid to the nose, each being surrounded by a prolongation of the membranes of the brain. They form an inner and an outer group. The former lie at first in shallow grooves on the perpendicular plate of the ethmoid, and then break up into tufts to the mucous membrane of the upper third of the septum. The latter are similarly distributed to the mucous membrane over the superior turbinated bone, except at its lower edge. The olfactory nerves are composed of non-medullated fibres.

Optic Nerve.

Investigation in the paths of Experimental Physiology and Pathology teaches the following in regard to the fibres of the optic nerve, tract, and commissure:—

The optic nerve, as distinguished from the tract and commissure, is derived from

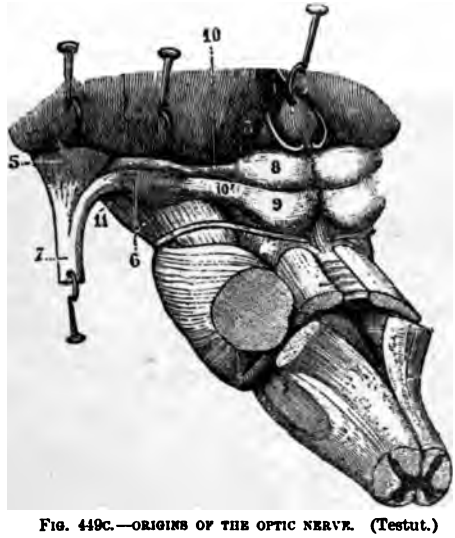


FIG. 449c.—ORIGINS OF THE OPTIC NERVE. (Testut.)

8 and 9 anterior and posterior quadrigeminal bodies with 10 and 10', their respective brachia; 5 and 6, external and internal geniculate bodies; 7, optic tract. The other indications are deleted; the figure will be found fully explained, page 305.

the pulvinar, and from *anterior* quadrigeminal and *external* geniculate bodies only, not from the posterior quadrigeminal and internal geniculate bodies.

The optic tract and commissure have additional fibres (Gudden's fibres) derived from the internal geniculate bodies, and perhaps from the posterior quadrigeminal bodies (Testut); these fibres are merely commissural, and form but the innermost fibres of

one tract, the posterior fibres of the commissure, and then the innermost fibres of the opposite tract, – thus returning to the centres of the opposite side of the brain; they form no part of the optic nerves proper.

The fibres common to the optic tract and commissure, *and* to the optic nerve, are divisible into *crossed* and *direct*. The former alone exist in animals whose vision is monocular, and are still in man the most numerous and most important. The latter fibres appear, in the animal series, with binocular vision, and are *relatively* most numerous in man. The *crossed fibres* occupy the inner part of the tract, the central and anterior parts of commissure, and the inner part of the optic nerve proper, and supply, in man, the inner *two-thirds* of the retina. The *direct fibres* occupy the outer part of the tract, commissure, and nerve, and supply, in man, the *outer third* of the retina; even in the higher vertebrates (except monkeys), the retinal area supplied by these fibres is far less than in man. It will be seen that, functionally, it is the peripheral part of the field of vision that is subserved by the crossed, and the more central part of the field that is subserved by the direct fibres.

Ligament of Zinn.

Is essentially a thickening of the periosteum of the optic foramen, presenting lower and upper expansions, which bridge over, the one, the lower and inner part of the sphenoidal fissure, and the other, the upper and outer part. The lower expansion, or *inferior orbital tendon of Zinn*, is the most marked, and corresponds to the origins of the inferior rectus, and of the lower part of the internal and external recti (lower head of the latter). The upper expansion, or *superior orbital tendon of Lockwood*, is much thinner; it gives origin to the superior rectus, and to the upper part of the internal and external recti. The lower expansion extends from the inner side of the optic foramen to the small spine on the orbital surface of the greater wing of the sphenoid, from which arises (partly) the lower head of the external rectus; the upper expansion returns from the above spine to the ridge of bone on the outer side of the optic foramen. Both expansions are prolonged to some extent into the muscles arising from them, these prolongations being best seen on the surface of the several muscles which is turned towards the eye-ball.

Tenon's Capsule, and Orbital Cone of Fat.

The back part of the orbit is occupied by a conical mass of soft and large-grained fat hollowed out anteriorly for the reception of the eye-ball. Tenon's capsule is interposed between the anterior part of this cone of fat and the eye-ball. It is a loose cellular membrane spread out over the whole of the back part of the eye-ball and reaching as far as the cornea. In its central parts it presents two layers, orbital and ocular, separated by a serous cavity. The *orbital layer* lines the cavity of the cone of fat, and is prolonged backwards round the optic nerve as a double lymphatic sheath continuous on the one hand with the sub-dural lymph space, and on the other hand with the sub-arachnoid. The ocular layer is applied to the back part of the eye-ball, from which it is separated by very loose connected tissue. Peripherally, the capsule is continuous with the subconjunctinal tissue, and is attached to the external and internal palpebral ligaments and to the margin of the orbit. Tenon's capsule is perforated by the tendons of the muscles which move the eye-ball, the openings being strengthened centrally by bands attached to the periphery of the orbit, – pulleys of reflection protecting the eye-ball from pressure, – and being, specially in the case of the recti, prolonged backwards upon the muscles in

the shape of sheaths. On their ocular side, or side of pressure, the tendons are somewhat adherent to the sheaths, and, through these, to Tenon's capsule generally: when divided, as in tenotomy, the muscles only retract incompletely, and still continue to act indirectly upon the eye-ball, or upon the stump left after enucleation. The sheath which the capsule supplies to the inferior rectus is prolonged into the lower eye-lid in front of the tarsal cartilage, and gives origin to a lamella of unstriped muscular fibres, known as the "Musculus palpebralis inferior." (See Lockwood, *Journal of A. & P.*, vol. xx., part 1.)

Tentorium Cerebelli.

Under the name of *posterior petro-clinoid process*, the outer, convex, or attached border of the tentorium cerebelli is continued inwards from the upper border of the petrous portion of the temporal bone, partly to become attached to the posterior clinoid process, and partly to join the opposite half of the structure on the median line of the basilar groove. Under the name of *anterior petro-clinoid process*, the inner, concave or free border of the tentorium is similarly prolonged above the posterior petro-clinoid process to become attached to the anterior clinoid process. This inner or concave border of the tentorium forms the posterior and lateral boundaries of the *superior occipital foramen*, which is traversed by the crura cerebri, the superior peduncles of the cerebellum, and the basilar artery. The *fifth nerve* leaves the dura mater by passing under the fibrous arch formed by the convex border of the tentorium as it overlies the apex of the petrous portion of the temporal bone; it thus enters *Meckel's cave*.

Fifth Nerve.

The sensory portion of the nerve enlarges in Meckel's cave into a triangular plexus in whose meshes numerous nerve-cells are found, and which expands anteriorly into a crescentic lamina of ganglionic matter, the Gasserian ganglion. The plexus is covered by an endothelial layer, and is thus somewhat separated from the dura mater, and can easily be isolated; the ganglion itself, not similarly invested, is closely adherent to the dura mater, and therefore difficult to clean.

There are given off recurrent filaments to the dura mater both from the Gasserian ganglion, and from all three divisions of the fifth nerve, as well as from the pneumogastric and the hypoglossal. The fourth nerve would seem to give off similar filaments to the tentorium, but physiological experiment points to these being derived from the ophthalmic branch of the fifth.

The ophthalmic branch of the fifth appears to communicate in the outer wall of cavernous sinus with all three motor nerves to the orbital muscles, the third, the fourth, and the sixth.

Meckel's Ganglion.—*See* Pneumogastric and Spinal Accessory Nerves, p. 228h.

Submaxillary Ganglion.

It is the posterior of the several branches of communication between lingual or gustatory nerve and the submaxillary ganglion that is believed, on physiological grounds,

to convey to the ganglion its sensory and motor roots from the gustatory nerve and the chorda tympani respectively. The anterior branches of communication are now considered to be branches of distribution emanating from the ganglion, and running for a time in the course of the lingual fibres.

A diminutive *sublingual* ganglion is described by some anatomists on the filaments passing from the lingual nerve to the sublingual gland. And, as in the case of certain other ganglia, nerve-cells are said to be found in the part of the nerve adjacent to the ganglion. [The ganglia would thus seem to be less definite structures than was formerly believed, – merely principal collections of nerve-cells, which latter may be more or less scattered, as in the above instance. The cells of the ganglia on the posterior roots of the spinal nerves may spread more or less into the sensory root, or even into the spinal nerve itself. The lenticular ganglion is sometimes smaller than usual, probably from its nerve-cells being distributed along the nerves connected with it.—Quain.]

The inferior dental nerve has not unfrequently an additional root arising directly from the Gasserian ganglion, and remaining separate from the main trunk till both have entered the inferior dental canal. This is the *lesser dental nerve of Sapolini*.

Otic Ganglion.

Since it has been the fashion to base so-called precise Anatomy on physiological data, the statements of scientists in regard to the roots and communications of the otic ganglion have become somewhat confusing. The following is simply transcribed from the most authoritative *exposé* of the subject, the last edition of Quain's Anatomy. It will be noticed that the tensor palati and tensor tympani muscles are no longer stated to be supplied by the facial nerve, but by the nerve to the internal pterygoid, – the branch from this nerve to the tensor tympani muscle passing through a small oval opening in the

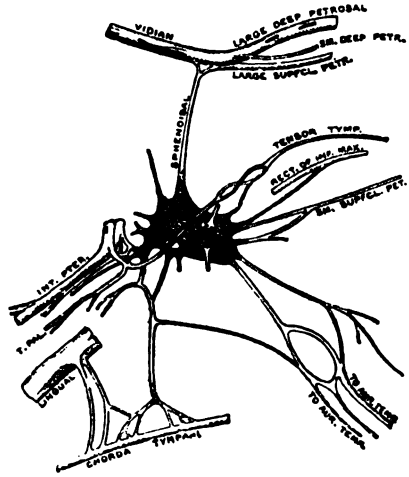


FIG. 449D.—THE OTIC GANGLION AND ITS COMMUNICATIONS. (*Quain after Rauber.*)

ganglion; and that the communication with the auriculo-temporal nerve, formerly considered as a sensory root of the ganglion, is now said to be a branch (excito-secretory) to the parotid gland.

"The otic ganglion receives, through its connection with the nerve to the internal pterygoid, fibres from the inferior maxillary nerve, and these may be regarded as constituting its *motor* and *sensory roots*; the *sympathetic root* is a filament or two passing forwards from the plexus on the middle meningeal artery. The ganglion is also joined posteriorly by the small superficial petrosal nerve, which connects it with, and probably conveys to it fibres from, the facial and glosso-pharyngeal nerves; and a slender sphenoidal filament ascends from it to the Vidian nerve."

"The branches are as follows:—(*a*) Two or more pale branches pass backwards to the roots of the auriculo-temporal nerve, and convey secretory fibres from the glosso-pharyngeal nerve to the parotid gland; (*b*) A communicating branch descends to the chorda tympani; (*c*, *d*, *e*) Slender filaments pass from the ganglion to the nerves supplying the internal pterygoid, tensor palati, and tensor tympani muscles; (*f*) A filament joins the buccal nerve."

Pneumogastric and Spinal Accessory Nerves.

The *pharyngeal branch* of the pneumogastric is now believed to consist mainly of motor fibres derived from the bulbar or accessory portion of the spinal accessory; and the motor fibres from this source are now said to reach, not only the *constrictor muscles of the pharynx*, but also the muscles of the soft palate, the tensor palati excepted. [The current statement to the effect that the *levator palati* and *azygos uvulæ* receive their nerve supply from the facial nerve through Meckel's ganglion must therefore be revised, though, of course, on purely physiological grounds.] The *tensor palati* is said to be supplied from the inferior maxillary nerve through its internal pterygoid branch and the otic ganglion; and the *tensor tympani* is said to be supplied in the same way (Quain). This also is stated, of course, on physiological grounds. The stylo-pharyngeus and the middle constrictor (the latter in part) are still said to be supplied by the glosso-pharyngeal.

Both pneumograstic and facial nerves appear to give off branches to the *tongue*. The lingual branch of the *pneumograstic* (Lushka) is a slender filament of the pharyngeal plexus, derived, in all probability, from the spinal accessory and the glosso-pharyngeal; it is said to reach the tongue by joining with the hypoglossal nerve as it winds round the occipital artery. The lingual branch of the *facial* is said to leave the trunk of that nerve near the stylo-mastoid foramen, and to cross the outer surface of the stylo-pharyngeus and the superior constrictor, joining with the glosso-pharyngeal, and then to reach the base of the tongue by passing between the tonsil and the anterior pillar of the fauces; it is said to supply the stylo-glossus and the stylo-pharyngeus, and, along with the glosso-pharyngeal, the papillæ of the mucous membrane. (Testut.)

The Recurrent Laryngeal Nerves.

The *left recurrent laryngeal* nerve embraces the arch of the aorta on the *left side* of the ductus arteriosus. This relation is significant. Correctly speaking, and as

distinctly seen in the embryo, the left recurrent laryngeal embraces, not the arch of the aorta at all, but the ductus arteriosus, at first horizontal in direction and subjacent (caudal) the aorta. Its coming to embrace the arch of the aorta is due to the lengthening out of the latter vessel, by which the duct is pulled upwards distally, and so comes to assume a vertical direction, and thus to lie on the side (the right side) of the recurrent laryngeal nerve, while it is the aorta that gets to lie above the nerve.

The final arrangement on the *right side*, where the recurrent laryngeal nerve embraces the first portion of the subclavian artery, is reached by a similar retrogressive change, but pushed somewhat further. The first right aortic arch, which corresponds embryologically to the ductus arteriosus, disappears entirely, and the nerve thus gets to hitch round the arch above, or second aortic arch, or first part of the subclavian artery.

Why the nerves are recurrent at all, and hitch round (or are drawn down by) corresponding vessels on the two sides of the neck, is as follows: Thorax and neck were undifferentiated, and the neck absent, or extremely short, in the early stages of embryonic life; and the nerves, when first formed, went straight to the larynx, passing below, or internally to, the large vessels referred to. Later on the lengthening out of the neck occurred, and the heart dragged down the large vessels into the now differentiating thorax; and the vessels dragged down the nerves, which thus came to hitch round them.

Facial Nerve.

The *portio intermedia of Wrisberg* has its deep origin in the upper part of the glosso-pharyngeal nucleus, and often communicates at its emergence with both the auditory and the facial. It is closely connected with the geniculate ganglion, and probably sends some filaments also in the course of the large petrosal; but it seems to run mainly in the course of the chorda tympani.

The chorda tympani, in addition to the above source of origin, receives a communicating branch from the otic ganglion, as above stated, before it joins the gustatory. Then, running in the course of the latter nerve, it shares its distribution to the submaxillary and sublingual glands, and to the papillæ of the mucous membrane of the anterior two-thirds of the tongue. The facial nerve sends also other branches to the tongue (See page 228h).

Jacobson's and the Petrosal Nerves.

The nomenclature of the petrosal nerves has long called for revision; and this is specially the case since the minute investigations of Krause have somewhat disturbed the harmonious and parallel description of these nerves as formerly given.

As the old description went, – as given by Continental anatomists (Sappey, Testut, & others), the facial nerve gives off the large *superficial* petrosal nerve 3 (Fig. 449*e*) (going to Meckel's ganglion), and the small *superficial* petrosal nerve, 15 (going to the otic ganglion); and Jacobson's branch of the glosso-pharyngeal gives off the large *deep* petrosal nerve joining the large superficial petrosal nerve (and going with it to Meckel's ganglion), and the small *deep* petrosal nerve joining the small superficial petrosal nerve

(and going with it to the otic ganglion). Matters now stand thus: While, on the one hand, the LARGE PETROSAL NERVE (the compound nerve which goes to Meckel's ganglion) is still admitted by all, as formerly, to be derived from the two sources named, – namely, the large superficial petrosal branch of the facial, and the large deep petrosal branch of Jacobson's nerve (Quain calls the latter the *small* deep petrosal nerve*), – on the other hand, the SMALL PETROSAL NERVE, as it used to be called (the compound nerve which goes to the otic ganglion), is no longer considered to have a quite similar double origin; it is no longer considered to be formed from the two sources formerly named, – namely, the small superficial petrosal branch of the facial, and the small deep petrosal branch of Jacobson's nerve. It would appear from Krause's investigations that the portion of this small petrosal nerve derived from the glosso-pharyngeal preponderates largely (it is shown to be somewhat the larger in Hirschfeld's figure as given below) over the portion derived from the facial, and that this latter portion is indeed quite insignificant. This former facial portion of the small petrosal nerve now becomes, therefore, a mere "filament of communication from the geniculate ganglion" (Quain); while the former small deep petrosal branch of Jacobson's nerve becomes *the* small petrosal nerve, or, as Quain calls it, the "small

FIG. 449E.—JACOBSON'S AND ARNOLD'S NERVES, AND THEIR COMMUNICATIONS. (Hirschfeld.)

1, right facial nerve in internal auditory meatus, & first portion of aqueductus Fallopii; 5, the same as it turns backwards in the aqueduct; 6, the same as it turns downward in the same canal. (The nerve is shown as drawn backwards at its exit from the stylo-mastoid foramen, in order that it should not mask the view of the other structures depicted.) 2, portio intermedia of Wrisberg, joining the trunk of the facial in the internal auditory meatus, and reaching the geniculate ganglion, which latter is seen at the anterior angle of the first bend of the facial nerve; 3, large superficial petrosal nerve going to Meckel's ganglion, 4; 15, small superficial petrosal nerve going to the otic ganglion, 16; 7, Arnold's auricular branch of the pneumogastric; 8, chorda tympani divided (the dotted line should have been prolonged across the facial nerve); 9, petrous ganglion of the glosso-pharyngeal, or ganglion of Andersh; 10, Jacobson's nerve 11, its filament to the carotid plexus, 12; 13, large deep petrosal nerve joining the large superficial petrosal, and going with it to Meckel's ganglion; 14, small deep petrosal nerve joining the small superficial petrosal nerve, 15, and going with it to the otic ganglion, 16; 17, 18, 19, branches of distribution of Jacobson's nerve to the fenestra rotunda, fenestra ovalis, and Eustachian tube.—(Hirschfeld.)

superficial petrosal" nerve. Thus the facial nerve is now said to give off the superficial petrosal nerve, or "external superficial petrosal nerve" (Quain), going to Meckel's ganglion, and a communicating branch to the small superficial petrosal; and Jacobson's nerve is said to give off this small superficial petrosal nerve (going to the otic ganglion), and the "small deep petrosal nerve"* (going to Meckel's ganglion). Evidently the petrosal nerves require re-naming.

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* The term "large deep petrosal nerve" is now applied in Quain's Anatomy to the sympathetic root of Meckel's ganglion, – that is to say, the branch of the sympathetic passing from the carotid plexus to this ganglion.

In Sömmering's classification the glosso-pharyngeal nerve becomes *the smallest of the three nerves that leave the cranium through the jugular foramen.*

In regard to the apparent origins of this nerve and of the pneumogastric and spinal accessory, Fig. 358B will show that it would be structurally more correct to put it simply that the *glosso-pharyngeal*, *pneumogastric*, and *accessory portion* of the spinal accessory arise from the *groove between the olivary and restiform bodies:* from the olive upwards the lateral tract ceases to exist as a distinct element of the medulla. On similar lines one would put it that the *facial* and *auditory* nerves arise from the *fossa* which results from the widening out of the above-mentioned groove at the upper part of the medulla (fossette laterale du bulbe, fossette sus-olivaire—Sappey), the facial nerve being here *above and in front of* the auditory. At its origin the facial nerve very frequently adheres to the lower border of the pons where the latter is passing into the middle peduncle of the cerebellum.

The bulbar or accessory portion of the spinal accessory nerve appears merely to run on the surface of the ganglion of the root of the pneumogastric, and then to be distributed along with the pharyngeal & superior laryngeal branches of the nerve. The motor filaments which do not leave the pneumogastric as above cleave to the trunk for a short distance, but eventually leave it in the recurrent laryngeal nerve, and probably also in the cardiac nerves as well (*inhibitory fibres*).

EXPLANATION OF FIGURES NOT FULLY EXPLAINED IN THE TEXT.

FIG. 364.—DIAGRAM OF THE ROOTS AND COMMUNICATING BRANCHES OF THE PNEUMOGASTRIC AND NEIGHBOURING NERVES. (Hirschfeld.)

(1) Facial nerve; (2) glosso-pharyngeal nerve, with the petrosal ganglion; 2, connection of the digastric branch of the facial nerve with the glosso-pharyngeal nerve; (3) pneumogastric nerve, with its two ganglia; (4) spinal accessory nerve; (5) hypoglossal nerve; (6) superior cervical ganglion of sympathetic; 7, 7, loop of union between the first two cervical nerves; 8, carotid branch of sympathetic; (9) nerve of Jacobson (tympanic), given off from the petrosal ganglion; 10, its carotico-tympanic filaments; 11, twig to Eustachian tube; 12, twig to fenestra ovalis; 13, twig to fenestra rotunda; (14) small superficial petrosal nerve; (15) large superficial petrosal nerve; (16) otic ganglion; 17, auricular branch of pneumogastric; 18, connection of spinal accessory with pneumogastric; 19, union of hypoglossal with first cervical nerve; 20, union between the sterno-mastoid branch of the spinal accessory and that of the second cervical nerve; 21, pharyngeal plexus; 22, superior laryngeal nerve; 23, external laryngeal; 24, middle cervical ganglion of sympathetic.

FIGS. 366 & 404.—ORIGINS OF THE 9TH, 10TH, 11TH, & 12TH NERVES: NERVES SUPPLYING THE TONGUE. (Hirschfeld.)

1, medulla oblongata; (2, 3, 4, 5) glosso-pharyngeal, pneumogastric, superior laryngeal, and spinal accessory nerves; 5, 7, 8, 9, the four first cervical nerves, the second showing the ganglion on posterior root; (10) lingual or gustatory nerve; 11 to 22, HYPOGLOSSAL NERVE:—11, its origin from the front of the medulla: the nerve is seen passing between the spinal accessory and the pneumogastric, crossing the latter, and joining with the two first cervical nerves, 12, 13; 14, 15, descendens hypoglossi and communicans cervicis; 16, nerve to thyro-hyoid; 17, 18, 19, 20, branches to muscles of tongue; 21, 22, anastomoses with lingual. A, B, C, D, E, vertebral, external carotid, lingual, temporal, and internal maxillary arteries; *a*, condyle of occipital bone pierced by hypoglossal nerve; *b*, section of atlas; *c*, styloid process; *d*, *e*, *f*, *g*, *e*, stylo-, hyo-, and genio-hyo-glossi, and stylo-pharyngeus muscles; *h*, *i*, external and internal pterygoid muscles.

FIGS. 374 and 406.—DISTRIBUTION OF THE LINGUAL, HYPOGLOSSAL, AND SPINAL ACCESSORY NERVES. (Hirschfeld.)

1, lingual nerve; (2) pneumogastric nerve; 3, superior laryngeal (represented too large); 4, external laryngeal branch; (5) spinal accessory; 6, second cervical; 7, third; 8, fourth; 9, origin of phrenic nerve; 10, nerve to subclavius; 11, external anterior thoracic nerve; (12) hypoglossal nerve; 20, its branch to the thyro-hyoid muscle; (13) descending cervical nerve; 15, 16, 17, 18, 19, branches from the ansa hypoglossi to the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles; 21, communicating twigs from the hypoglossal to the lingual nerve; 22, terminal branches of the hypoglossal nerve.

FIGS. 380 and 387.—SUPERFICIAL DISTRIBUTION OF THE FACIAL, TRIGEMINAL, AND OTHER NERVES OF THE HEAD. (Sappey, Hirschfeld.)

(1) Trunk of the facial nerve after its exit from the stylo-mastoid foramen; 2, posterior auricular branch; 3, filament of the great auricular nerve uniting with the foregoing; 4, occipital branch; 5, auricular branch; 6, twig to the superior auricular muscle; 7, nerve to the digastric; 8, that to the stylo-hyoid muscle; (9) temporo-facial division of the nerve; 10, 11, temporal branches; 12, malar; 13, 14, infra-orbital; (15) cervico-facial division of the nerve; 16, mandibular, and above this the buccal branches; 17, cervical branch; (18) Auriculo-temporal, uniting with the facial, giving anterior auricular and parotid branches, and ascending to the temporal region; 19, 20, supra-orbital; 21, lachrymal; 22, infra-trochlear; 23, malar twig of the temporo-malar; 24, superficial branch of the nasal; 25, infra-orbital; 26, buccal, uniting with branches of the facial; 27, mental; (28) great occipital; (29) great auricular; 30, 31) small occipital; (32) superficial cervical.

FIG. 384.—THE COMMUNICATIONS OF THE RIGHT FACIAL NERVE WITH JACOBSON'S NERVE AND MECKEL'S AND THE OTIC GANGLIA. (Hirschfeld.)

(See page 2281.)

FIGS. 381 and 383.—RIGHT FACIAL NERVE IN THE INTERNAL AUDITORY MEATUS, AS SEEN FROM ABOVE.

(1) Facial nerve in the internal auditory meatus, resting upon the auditory nerve (5); (2) its geniculate ganglion, from which there passes forwards the large superficial petrosal nerve (3). A little beyond the ganglion the nerve is seen as it is turning backwards, as shown in the next figure. *b*, cochlea; *c*, semicircular canals; *d*, upper part of the malleus & incus, with the chorda tympani (4) passing between them inferiorly; 6, Gasserian ganglion, with the three divisions of the fifth nerve; *e*, tensor tympani muscle.

FIGS. 382 and 388.—RIGHT FACIAL NERVE IN THE AQUEDUCTUS FALLOPII, AS SEEN FROM THE OUTER SIDE.

(1, 1, 3, 4) Facial nerve in the first horizontal part of its course, its second horizontal part turning backwards, its vertical descending portion, and at its exit from the stylo-mastoid foramen; (5) geniculate ganglion; (6) large superficial petrosal nerve, which is seen to be joined inferiorly by the large deep petrosal branch of Jacobson's nerve; (7) Meckel's ganglion; (8) small superficial petrosal nerve, similarly joined by the small deep pretrosal branch of Jacobson's nerve; (9) chorda tympani, seen passing between the handle of the malleus and the long process of the incus; 10, posterior auricular nerve, cut short; 11, 12, branches to stylo-hyoid and posterior belly of digastric; 13, twig to the glosso-pharyngeal; (14) glosso-pharyngeal nerve.

FIG. 417.—GASSERIAN GANGLION, AND SUPERFICIAL NERVES OF THE ORBIT. (Sappey, Hirschfeld.)

III., IV., VI., third, fourth, and sixth nerves; V., large or sensory root of the fifth nerve, leading to the Gasserian ganglion, 1: a small portion of the motor root is seen projecting from beneath the sensory root; (2) trunk of the ophthalmic nerve in the outer wall of the cavernous sinus. The fourth nerve is seen lying immediately to its inner side. (3) Lachrymal nerve; (4) frontal nerve, with its supra-trochlear division, 7, and the external and internal branches of its supra-orbital divisions, 5 & 6; (8) nasal nerve, seen further on in the anterior ethmoidal foramen, and entering the slit by the crista galli to the nose; 9, its infra-trochlear branch.

I., olfactory tract and bulb; II., chiasma of the optic nerves.

11., anterior deep temporal nerve, arising in common with the buccal nerve; 12, a middle deep temporal nerve; 13, posterior deep temporal nerve; 14, origin of the auriculo-temporal nerve; 15, large superficial petrosal nerve.

FIG. 424.—DEEP NERVES OF THE ORBIT. (Sappey.)

(1) Third nerve, dividing into a small uperior branch, 2, which is seen supplying the levator palpebræ superioris & superior rectus, and a larger inferior branch, which is seen to supply the internal & inferior recti, 4 & 5, and to be continued beneath the eyeball to the inferior oblique. (From this latter there is seen given off the short or motor root of the lenticular ganglion, 7, which has been divided close to its origin.) (9) Sixth nerve, which is seen supplying the external rectus muscle; 10, ciliary nerves, piercing the sclerotic round the optic nerve, and passing forwards between the sclerotic & the choroid.

FIG. 425.—NERVES OF THE ORBIT SEEN FROM THE OUTER SIDE. (Sappey.)

The external rectus has been divided and turned down, its posterior part showing the ramifications of the sixth nerve, 5, on its inner surface. 1, optic nerve; (2) trunk of the third nerve, its upper branch going to the levator palpebræ superioris & superior rectus; (4) its long lower branch, ending in the inferior oblique muscle.

6, Gasserian ganglion; 7, ophthalmic nerve, with its nasal branch, 8.

9, ciliary or lenticular ganglion, with its three roots, - short or motor, 10, long or sensory, 11, and sympathetic, 12.

FIG. 444.—SUPERIOR MAXILLARY NERVE AND MECKEL'S GANGLION FROM THE OUTER SIDE. (Sappey, Hirschfeld.)

(1) Casserian ganglion; (3) superior maxillary nerve; 15, terminal branches on the face, seen joining with facial nerve, 16; (13, 14) superficial posterior dental branches; (4) orbital branch); 6, its malar twig, divided; 7, its temporal twig, joined at 5 by a twig from the lachrymal nerve, 2; (8) Meckel's ganglion; (9) Vidian nerve; (10) its motor root, or large superficial petrosal nerve, derived from the facial nerve, 11; (12) its sympathetic root.

FIG. 445.—SUPERIOR MAXILLARY NERVE AND MECKEL'S GANGLION FROM THE OUTER SIDE. (Sappey, Hirschfeld.)

(1) Superior maxillary nerve; (2) deep posterior dental nerve; 3, superficial posterior dental nerve, divided; (4) anterior dental nerve; 5, superior dental plexus; (6) Meckel's ganglion; (7) Vidian nerve; 8, its motor root, or large superficial petrosal nerve; 9, its sympathetic root.

10, part of sixth nerve, receiving twigs from carotid plexus; 11, superior cervical ganglion of the sympathetic; 12, its ascending branch to the internal carotid artery.

(13) Facial nerve in aqueductus Fallopii.

(14) Glosso-pharyngeal nerve; 15, its tympanic branch, or Jacobson's nerve; 16, twig joining sympathetic on internal carotid artery; 17, 18, 19, filaments to fenestra ovalis, and mucous membrane of Eustachian tube; 20, small deep petrosal nerve, joining small superficial petrosal branch of facial divided, 21.

FIG. 446.—MECKEL'S GANGLION SEEN FROM THE INNER SIDE, AND NERVES TO THE NOSE. (Sappey, Hirschfeld.)

(3) Meckel's ganglion; 4, its anterior or great palatine nerve, whose branches to the inferior turbinated bone are seen in 7; 5, and 6, small, and external palatine nerves; 8, superior nasal nerve; 9, naso-palatine nerve, divided; (10) Vidian nerve; 11, its motor root, or large superficial petrosal branch of facial; 13, cavernous plexus.

FIG. 447.—THE OTIC GANGLION, SEEN FROM THE INNER SIDE. (Sappey, Hirschfeld.)

(8) Otic ganglion; (9) small superficial petrosal nerve; 11, twig connecting the ganglion with the auriculo-temporal nerve; 12, twig from the sympathetic on the middle meningeal artery; 10, branch to the tensor tympani muscle; 13, nerve to the internal pterygoid muscle; 14, nerve to the tensor palati.

(1) Small or motor root of fifth nerve, passing down on inner side of Gasserian ganglion to join with the inferior maxillary nerve; (2) inferior dental nerve, giving off its mylo-hyoid branch (3), which is seen further down emerging from beneath the internal pterygoid muscle; (4) lingual nerve, with the chorda tympani (5); 6, descending portion of the facial nerve in the aqueductus Fallopii; (7) auriculo-temporal nerve, enclosing the middle meningeal artery between its two roots.

A portion of the facial nerve has been removed so as to open up the aqueductus Fallopii, and to show the membrani tympani with the incus & the stapes.

FIG. 448.—THE OTIC GANGLION FROM THE OUTER SIDE; THE DEEPER NERVES OF THE HEAD AND NECK, AND MORE PARTICULARLY THE DEEP CONNECTIONS OF MECKEL'S AND THE OTIC GANGLIA WITH THE PETROSAL AND JACOBSON'S NERVES. (Hirschfeld.)

(See Fig. 398, on page 187a, for earlier dissection of the same "part.")

(1) Ophthalmic nerve, divided at its origin from the Gasserian ganglion. Its lachrymal branch is also divided, and the contents of the orbit are removed, to give a better view of its nasal branch and the infra-trochlear offset of the latter;

(2) **Superior maxillary** nerve, similarly divided at its origin and cut short anteriorly ; 7 & 8, its deep posterior and its anterior dental branches, joining in a plexus in the outer wall of the antrum of Highmore, from which the teeth of the upper jaw are supplied ; (3) **Meckel's ganglion**, with the **Vidian nerve** fully exposed in the Vidian canal, the latter nerve showing both its connection with the carotid plexus and with the large superficial and large deep petrosal branches of the facial and glosso-pharyngeal (Jacobson's nerve). (See also Fig. 449B.)

(9) **Otic ganglion** exposed from without by the removal of the upper part of the inferior maxillary nerve. There are seen reaching the posterior aspect of the ganglion the conjoined small superficial petrosal nerve of the facial, and the small deep petrosal of the glosso-pharyngeal (Jacobson's nerve.) (See also Fig. 449B.) The communication of the ganglion with the chorda tympani is shown.

(20) **Glosso-pharyngeal nerve** and its petrous ganglion or ganglion of Andersh, with **Jacobson's nerve** traced up to the tympanum, the latter, showing its branches of distribution to the fenestræ, rotunda, & ovalis, and its branches of communication with the carotid plexus and with the large superficial petrosal and small superficial petrosal branches of the facial. (See page 228h and figure above referred to.

(10) **Lingual or gustatory nerve**, receiving the chorda tympani, 11, which has been divided superiorly in the removal of the outer wall of the tympanum ; 13, its anastomosis with the hypoglossal ; (12) **submaxillary ganglion**, with its communications and branches of distribution ; 14, sublingual ganglion sometimes present ; (16) inferior **dental nerve**, giving off the nerve to the mylo-hyoid ; 18 & 19, mental and incisor branches of the inferior dental, the former cut short.

(22) **Hypoglossal nerve**.

c, inner wall of the tympanum, showing the fenestræ, rotunda, & ovalis ; *f*, mylo-hyoid muscle detached from the mylo-hyoid ridge of the lower jaw.

FIG. 399.—THE SUBMAXILLARY TRIANGLE. (Ellis.)

1, 2, gustatory nerve with the submaxillary ganglion ; 3, Wharton's duct ; 4, 6, 7, glosso-pharyngeal, hypoglossal, and superior laryngeal nerves. A, B, C, D, F, H, J, genio-hyo-glossus, genio-hyoid, hyo-glossus, stylo-glossus, posterior belly of digastric. The figure shows the common, internal, and external carotid arteries, with the superior thyroid, lingual, facial, and occipital branches of the latter, and the internal jugular vein.

SUMMARY OF PRACTICAL POINTS.

HEAD AND NECK.

The Scalp.—Firmly connected to the tendon of the occipito-frontalis, and moves with it. A scalp wound will generally divide the tendon.

Tendon of the Occipito-Frontalis.—But loosely connected to the pericranium. Between the two is a stratum of loose cellular tissue, which readily becomes the seat of diffuse inflammatory infiltration and sloughing.

Arteries of the Scalp. — *Frontal*, emerging from the superior internal angle of the orbit. *Supra-orbital*, emerging from supra-orbital notch or foramen at junction of inner and middle thirds of supra-orbital arch. *Temporal*, running between condyle of lower jaw and external auditory meatus, and then crossing the posterior root of the zygoma; divides into anterior and posterior branches. *Posterior auricular*, over front part of mastoid process. *Occipital*, about midway between mastoid process and external occipital protuberance. All these arteries are subcutaneous.*

* One is well repaid for a perusal of Mr. Treves's excellent chapter on the Scalp. See Treves's "Applied Anatomy."

External Occipital Protuberance.—Always perceptible to the finger. Corresponds to the torcular Herophili. Gives attachment to the ligamentum nuchæ. From either side of it spring the superior curved lines of the occipital bone, which give attachment to the trapezius, sterno-mastoid, and occipito-frontalis. The inferior curved lines are out of reach of the finger.

Frontal Sinuses.—Do not exist in childhood. They are formed, as age advances, by the separation of the two tables of the skull. The absence of the usual external prominence does not necessarily indicate the absence of the sinuses, which may be formed by the retrocession of the inner table of the skull. Neither does a prominent bump necessarily imply a large sinus. The same remark applies to the mastoid cells.

External Auditory Canal.—Runs forwards and inwards, with a slight concavity downwards, and is an inch and a quarter long in the adult. To straighten the canal for inspection the auricle should be drawn upwards and backwards. The *membrana tympani* is oblique downwards and inwards. It is slightly concave, and the handle of the malleolus can be seen adhering to its upper half.

Branches of the Fifth Nerve and Corresponding Vessels.—The *supra-orbital* nerve and artery emerge from the orbit through the supra-orbital notch or foramen at junction of inner and middle thirds of supra-orbital arch. The *infra-orbital* and *mental* foramina, with the corresponding vessels and nerves, are in a line drawn from this point to the interval between the bicuspid teeth of the lower jaw. The *auriculo-temporal nerve* emerges from under cover of the parotid gland behind the temporal artery, and accompanies the two branches of the latter.

Condyle of the Lower Jaw.—Can be felt, when the mouth is opened and shut, to glide forwards and backwards upon the eminentia articularis, in front of the external auditory meatus.

Ramus of the Jaw.—Incisions made over this should be horizontal in direction, so that they may avoid both Steno's duct and the facial nerve. *Steno's duct* runs along a line from the lower part of the concha to a point midway between the free margin of the lip and the ala of the nose. The trunk of the *facial nerve* passes downwards and forwards from the point where the anterior border of the mastoid process meets the ear.

Facial Artery.—Crosses the lower jaw in front of the masseter, where it can be felt and compressed. It passes upwards and forwards to near the angle of the mouth, where it lies close to the mucous membrane, and can be felt and compressed from within. Its coronary branches also lie near to the mucous membrane. The artery then ascends along the side of the nose to a little to the inner side of the tendo oculi, where it joins with the nasal branch of the ophthalmic.

Puncta Lachrymalia.—The lower one is slightly the larger, and the more external. The lower lachrymal canal runs first downwards and then inwards, forming an angle, which the surgeon obliterates, before introducing Weber's knife, by drawing the lower lid outwards.

Tendo Oculi.—Crosses the lachrymal sac a little above its middle. It is easily seen when made tense by drawing the lower lid outwards. A puncture just below it would enter the lower part of the lachrymal sac.

Nasal Duct.—Runs downwards, backwards, and outwards. It is from half to three-quarters of an inch in length, and ends in the inferior meatus of the nose. Its *inferior aperture* is sometimes on the roof of the meatus, when it is large and round, and sometimes on the outer wall of the meatus, when it is smaller and slit-like.

The Skin of the Nose.—Is firmly connected to the cartilages; hence the acute pain felt in erysipelas and small boils on the nose.

The Nostril, or Anterior Aperture of the Nose.—Is on a lower level than the floor of the nasal fossa. When raised, it allows of the inspection of the lower part of the nasal cavity, including the inferior turbinated bone.

Septum Nasi.—Is generally deviated a little to one side or other, narrowing the nasal fossa of that side.

Coronary Arteries.—Surround the buccal aperture lying close to the mucous membrane, and can be compressed from within the mouth. The hare-lip pins are passed *deeply* in the operation for hare-lip.

Steno's Duct.—Runs along a line drawn from the lower part of the concha to a point midway between the free margin of the lip and the ala of the nose, and opens on the summit of a small papilla opposite the second molar tooth of the upper jaw.

The Tongue.—Is rough over the anterior two-thirds of its dorsum, and smooth posteriorly. On its under surface, in front of the frenum, it presents a narrow median furrow. On either side of this are the ranine veins; these indicate the position of the corresponding arteries. The middle line of the tongue is but slightly vascular.

The Sublingual Glands.—Stand out on the floor of the mouth on either side of the frenum. On their inner side we find the sublingual artery, which is endangered when the frenum is too freely divided.

Tendons of the Genio-Hyo-Glossi.—May be felt in the middle line of the floor of the mouth, just behind the jaw-bone. Their division allows the tongue to be drawn very freely out of the mouth, as may be necessary in the removal of a cancer of the organ.

Sterno-Mastoid Muscle.—Stands out in bold relief when the face is turned towards the opposite side. When undissected, it curves forwards as far as the angle of the jaw, and covers nearly the whole of the common, external, and internal carotid arteries. It is crossed by the external jugular vein, which passes down from the angle of the jaw to near the middle of the clavicle. The anterior jugular vein lies some way in front of its anterior border.

Common Carotid Artery.—Extends from behind the sterno-clavicular articulation to the upper border of the thyroid cartilage, running along a line drawn from the articulation to a point midway between the angle of the jaw to the mastoid process. It is deep at its origin, and relatively superficial at its termination. The internal jugular vein lies on its outer side; the pneumo-gastric nerve lies between and behind the two vessels; the cord of the sympathetic lies behind the sheath of the artery; the descendens hypoglossi crosses the sheath anteriorly. The artery can best be compressed against the prominent anterior tubercle of the transverse process of the sixth cervical vertebra, called the carotid tubercle, or tubercle of Chassaignac. The artery is crossed at about the level of the cricoid cartilage by the anterior belly of the omo-hyoid muscle.

The Stylo-Hyoid and Posterior Belly of the Digastric.—Run obliquely downwards and forwards from the mastoid process to the hyoid bone. Beneath them passes the whole of the neuro-vascular bundle of the upper part of the neck

The hypoglossal nerve runs along their lower edge, and marks the point where the external carotid artery is usually tied.

Above and in front of these muscles lies the superficial portion of the submaxillary gland.

Beneath the submaxillary gland, in the angle between the two bellies of the digastric, is the anterior part of the hypoglossal nerve, just before it disappears beneath the mylo-hyoid. The nerve and the two bellies of the muscle bound a small triangular space (lingual triangle), of which the floor is formed by the hyo-glossus. The *lingual artery* crosses this space beneath the hyo-glossus muscle.

The *facial artery* grooves the upper and back part of the submaxillary gland, and then crosses the lower jaw in front of the masseter.

Between the sternal and clavicular heads of the sterno-mastoid lie the common carotid artery internally, and the internal jugular vein externally. The vein, at this level, is clearly external to the artery on the right side of the neck, while, on the left side, it approaches and sometimes crosses it. Between and behind the two vessels is the pneumo-gastric nerve. The phrenic nerve lies external to the vein, in front of the scalenus anticus.

Between the two sterno-mastoids, at the lower part of the neck, is the "fonticulus gutturis," which rises and sinks in distressed breathing.

The sterno-clavicular articulation marks the commencement of the innominate vein, and, on the right side, the division of the innominate artery.

The Supra-Clavicular Fossa.— Is crossed at its lower and inner part by the posterior belly of the omo-hyoid. Below, and then externally to this, it is crossed more or less horizontally, and at a somewhat variable level, by the *supra-scapular* and *transversalis colli* vessels; so that, in the ligature of the subclavian artery, the knife should be used with much care after the platysma and deep fascia have been divided.

The Triangle formed by the Scaleni Muscles corresponds pretty nearly to the outer border of the sterno-mastoid. Its base is formed by the first rib. Upon this rests the subclavian artery, which can here be controlled by pressure downwards and inwards upon the bone. Above the artery are the cords of the brachial plexus. The subclavian vein lies below and in front of the artery, in front of the scalenus anticus.

The Lung.—Rises half an inch or an inch above the clavicle, and its apex can be examined by auscultation and percussion through the soft parts of the supra-clavicular fossa.

(*See practical questions at end of book.*)

THE LARYNX

THE LARYNX—1st Tablet.

CARTILAGES — Nine; three single, three pairs; –

THYROID — The largest. Consists of two quadrilateral plates or *alæ* joined in front at an acute angle, the highest & most prominent part of which angle is termed the *pomum Adami*. Presents:

Outer Surface – Presents on either side the *Oblique Line* – For sterno-thyroid & thyro-hyoid; passes obliquely downwards & forwards from tubercle near root of superior cornu. The surface behind gives attachment to inferior constrictor.

Inner Surface – Covered by mucous membrane externally & above. Presents in middle line the *Receding Angle* – To which are attached the true & the false vocal cords, the thyro-arytænoidei & -epiglottidei muscles, and the thyro-epiglottic ligament & apex of the epiglottis.

Upper Border – Deeply notched opposite pomum Adami, rounded & prominent on either side of notch, concave laterally; gives attach. to thyro-hyoid membr.

Lower Border – Shorter, straighter, connected to cricoid cartilage by crico-thyroid membrane & muscle.

Posterior Border – Thick & rounded; gives attachment to stylo- & palato-pharyngei, and is prolonged upwards & downwards respectively into the *Superior Cornu* – Long, narrow; points upwards, backwards & inwards, and gives attachment to lateral thyro-hyoid ligament. *Inferior Cornu* – Shorter & thicker; points downwards forwards & inwards, and presents internally a small facet for articulation with cricoid cartilage.

CRICOID — Annular in shape, broad behind, narrow in front; thicker & stronger, but smaller than foregoing. Presents:

Outer Surface – Gives attachment in front & at sides to crico-thyroideus & inferior constrictor; and then presents on either side from before backwards: *Tubercle* – Surmounted by an articular facet, for articulation with lesser cornua of thyroid cartilage; *Broad Rough Depression* – For attachment of crico-arytænoideus posticus; *Median Vertical Ridge* – For attachment of longitudinal fibres of œsophagus.

Inner Surface – Smooth, lined with mucous membrane of larynx.

Upper Border – Inclined downwards & forwards. Gives attachment in front & at sides to crico-thyroid membrane & crico-arytænoideus lateralis, and presents at its posterior & highest part, on either side of a slight median notch, two small oval facets for articulation with arytænoid cartilages.

Lower Border – Horizontal; connected to first cartilaginous ring of trachea by fibrous membrane of that canal.

ARYTÆNOID — Two, small, pyramidal. Rest upon posterior & highest part of upper border of cricoid cartilage, and present:

Anterior Surface – Convex, rough; gives attachment to false vocal cord & upper fasciculus of thyro-arytænoideus.

Posterior Surface – Excavated for attach. of arytænoideus.

Internal Surface – The narrowest, flattened, covered with mucous membrane.

Base – Broad. Presents a smooth concave facet for articulation with cricoid cartilage, and three angles, of which angles two are prominent & important, viz., *Antero-Internal Angle* – Long & pointed; gives attachment to true vocal cord & to lower fasciculus of thyro-arytænoideus. *Postero-Ext. Angle* – Short & rounded; gives attach. to the crico-arytænoidei lateralis & posticus.

Apex – Pointed, curved backwards & inwards; articulates on either side with the

CORNICULA LARYNGIS or CARTILAGES of SANTORINI — Two small conical nodules of yellow elastic cartilage sometimes joined to apices of arytænoid cartilages, which apices they prolong backwards & inwards.

CUNEIFORM CARTILAGES or CARTILAGES of WRISBERG — Two small rods of yellow elastic cartilage directed upwards & outwards in free border of arytæno-epiglottidean folds a little in front of arytænoid cartilages; their anterior extremity is slightly enlarged.

EPIGLOTTIS — Median lamella of yellow elastic cartilage in the form of a leaf with the stalk below, and the lamina or expanded part above. Presents:

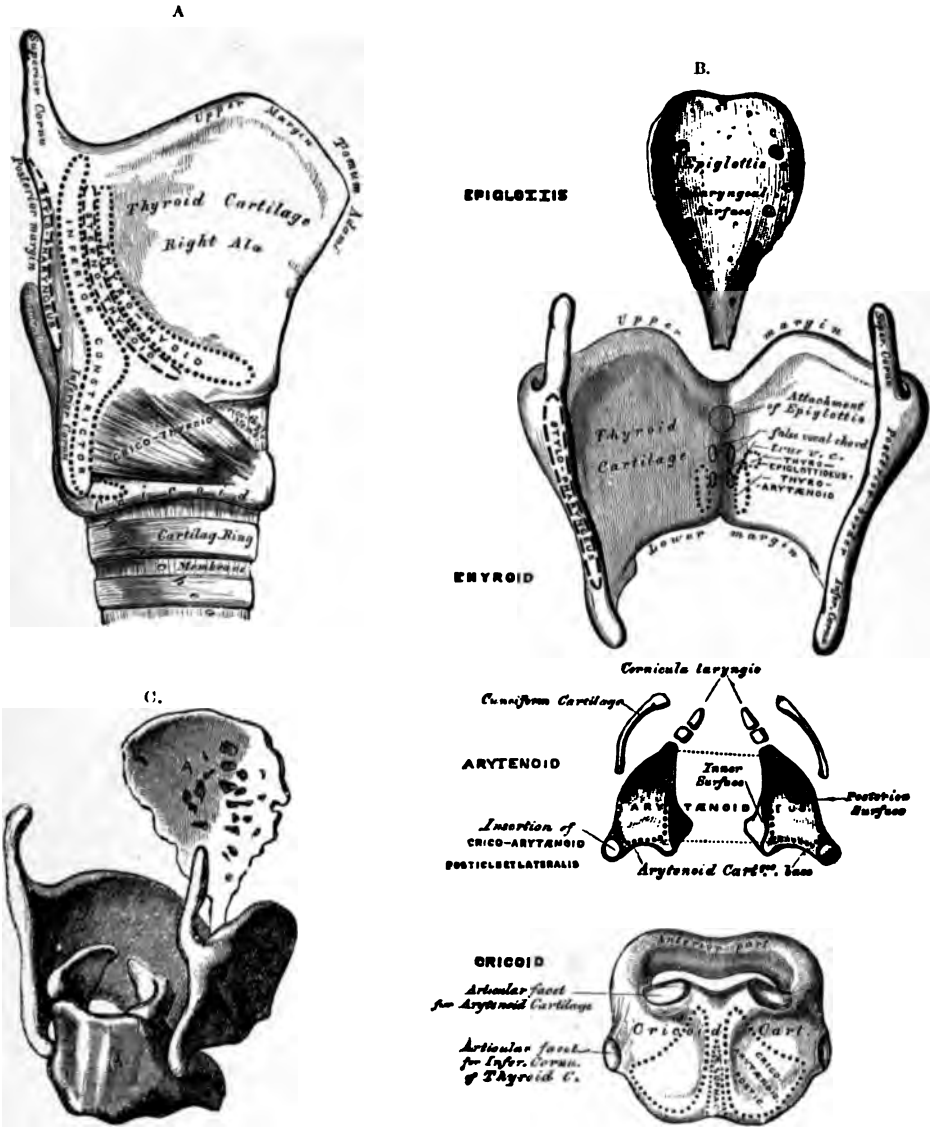
Apex – Long & narrow; attached by thyro-epiglottic ligament to upper part of receding angle of thyroid cartilage.

Base – Broad, rounded, free.

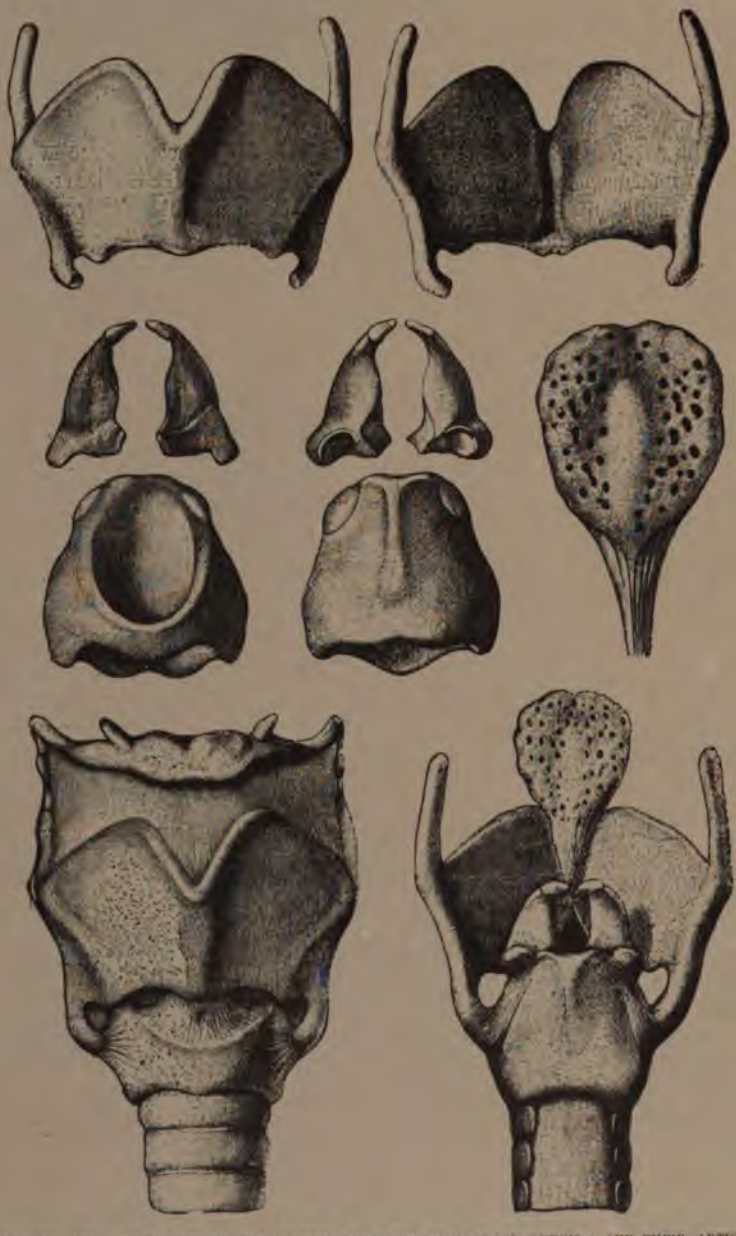
Anterior Surface – Free in its upper part, where it curves forwards towards base of tongue, to which it is connected by the three glosso-epiglottic folds; adherent below, where it is attached by hyo-epiglottic ligament to upper border of hyoid bone.

Posterior Surface – Free, smooth, concave from side to side, convex from above downwards. Covers superior aperture of larynx during second act of deglutition, and is studded with numerous small pits for the reception of mucous glands.

***Lateral* Margins** – Convex, directed backwards; connected to arytænoid cartilages by the arytæno-epiglottidean folds.



FIGS. 480, 481, 482.– CARTILAGES OF THE LARYNX. (A & B, Gray ; C, Ellis.)



Figs. 483, 484, 485, 486, 487.—CARTILAGES OF THE LARYNX SEEN FROM IN FRONT & BEHIND; AND THEIR ARTICULATIONS. (Sappey.)

THE LARYNX—2nd Tablet.

LIGAMENTS — Are:

EXTRINSIC — Three; connect larynx to hyoid bone. – They are:

Thyro-Hyoid Membrane – Broad fibro-elastic membrane from:
Upper border of thyroid cartilage to
Upper border of hyoid bone, being separated from posterior surface of hyoid bone by a little loose cellular tissue in which a bursa is usually found. It is thickest towards middle and perforated laterally by superior laryngeal vessels & nerves. Behind it are the epiglottis & the mucous membrane of the base of the tongue, with a considerable amount of adipose tissue & some mucous glands.

Lateral Thyro-Hyoid Ligaments – Rounded fibro-elastic cords from
Superior cornua of thyroid cartilage to
Extremities of greater cornua of hyoid bone. – These ligaments often contain a small cartilaginous nodule, the *cartilago triticea.*

INTRINSIC — Connect cartilages of larynx as follows: On the one hand the cricoid to the thyroid & arytænoid, on the other the epiglottis to the thyroid. – They are:

Crico-Thyroid Membrane – Yellow elastic lamina divided into:
CENTRAL PORTION – Thick, triangular, broadest below; connects
Contiguous margins of cricoid & thyroid.
LATERAL PORTIONS – Thinner; extend from
Upper border of cricoid cartilage as far back as crico-thyroid arthrodia to
Lower border of inferior or true vocal cord, uniting firmly with the latter, especially in front. – The central portion is concealed by crico-thyroid muscles, except in mesial line, and is crossed by crico-thyroid branches of superior thyroid arteries; the lateral portions are covered by the thyro- & lateral crico-arytænoid muscles, and are lined internally by mucous membrane of larynx.

Crico-Thyroid Capsules – Thin, strongest behind; enclose the arthrodial articulations between cricoid & inferior cornua of thyroid, and are lined internally with synovial membrane.

Posterior Crico-Arytænoid Ligament – Short but strong band from
Back of cricoid cartilage to
Back of base of arytænoid.

Crico-Arytænoid Capsules – Thin; surround the arthrodial articulations between upper border of cricoid cartilage & bases of the arytænoid, and are lined internally with synovial membrane.

Thyro-Epiglottic Ligament – Long & slender band connecting
Apex of epiglottis to
Upper part of receding angle of thyroid.

Hyo-Epiglottic Ligament – Somewhat indistinct; extends amidst a considerable amount of adipose tissue from
Anterior surface of epiglottis to
Upper border of hyoid bone.

To the foregoing ligaments must be added the superior & inferior thyro-arytænoid described with the vocal cords, and the somewhat indistinct fibro-cartilaginous capsules frequently found between the arytænoid cartilages & the corniculæ laryngis.

THE LARYNX—3rd Tablet.

MUSCLES of the GLOTTIS — Are four on each side, and one in the middle line.

Crico-Thyroideus – Front & sides of cricoid cartilage.
Lower border & inferior cornu of thyroid cartilage. – S. by superior laryngeal nerve.
Tilts the thyroid cartilage forwards, and thus elongates & tenses the vocal cords.

Thyro-Arytænoideus – Lower part of receding angle of thyroid cartilage, & posterior surface of crico-thyroid membrane.
By two fasciculi into anterior surface of arytænoid cartilage, and into anterior or internal angle of its base. – S. by recurrent laryngeal nerve.
Draws the arytænoid cartilage forwards, and thus shortens and relaxes the vocal cords; it also assists in compressing the sacculus laryngis. The former action is that of its lower & stronger fasciculus, which lies parallel with, & on the outer side of, the inferior or true vocal cord; the latter action is that of its upper & thinner fasciculus, which lies on the outer side of the sacculus laryngis.

Crico-Arytænoideus Lateralis – Side of upper border of cricoid cartilage.
External or posterior angle of base of arytænoid cartilage. – S. by recurrent laryngeal nerve.
The two muscles rotate the arytænoid cartilages so as to bring together their anterior or internal angles & the true vocal cords which are attached to them, and thus constrict the glottis.

Crico-Arytænoideus Posticus – Broad depression on side of posterior surface of cricoid cartilage.
External or posterior angle of base of arytænoid cartilage. – S. by recurrent laryngeal nerve.
The two muscles rotate the arytænoid cartilages so as to separate their anterior or internal angles & the true vocal cords which are attached to them, and thus dilate the glottis.

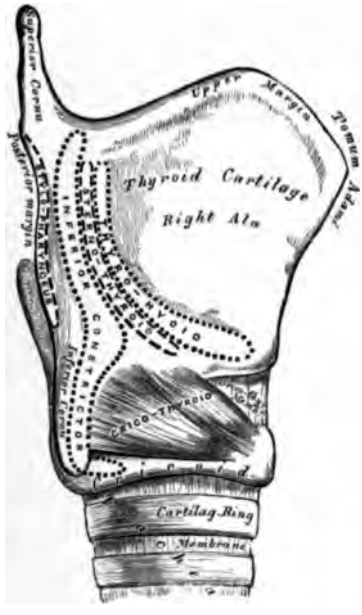
Arytænoideus – Posterior surface & outer border of both arytænoid cartilages, presenting superficial oblique & deep transverse fibres. – S. by both the superior & the inferior or recurrent laryngeal nerves.
The two muscles bring together the two arytænoid cartilages, and thus constrict the glottis, especially in its posterior part.

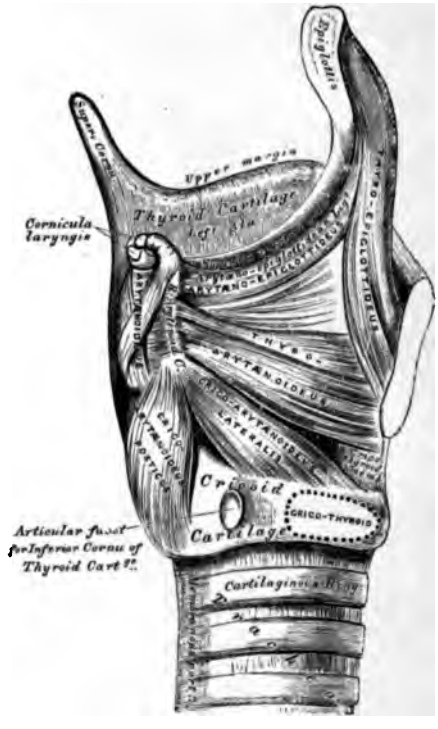
MUSCLES of the EPIGLOTTIS (As given in Gray) — Are three in number.

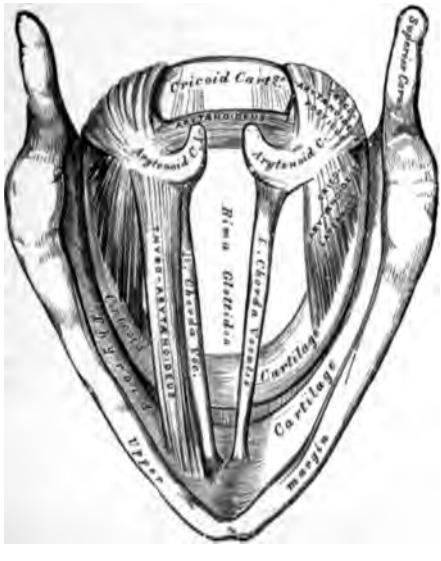
Thyro-Epiglottideus or Depressor Epiglottidis – Inner surface of the thyroid cartilage externally to origin of thyro-arytænoid.
Margin of epiglottis & arytæno-epiglottidean fold.
Depresses the epiglottis, and assists in compressing the sacculus laryngis.

Arytæno-Epiglottideus Inferior or Compressor Sacculi Laryngis – Arytænoid cartilage just above false vocal cord.
Margin of epiglottis.
Depresses the epiglottis, and assists in compressing the sacculus laryngis.

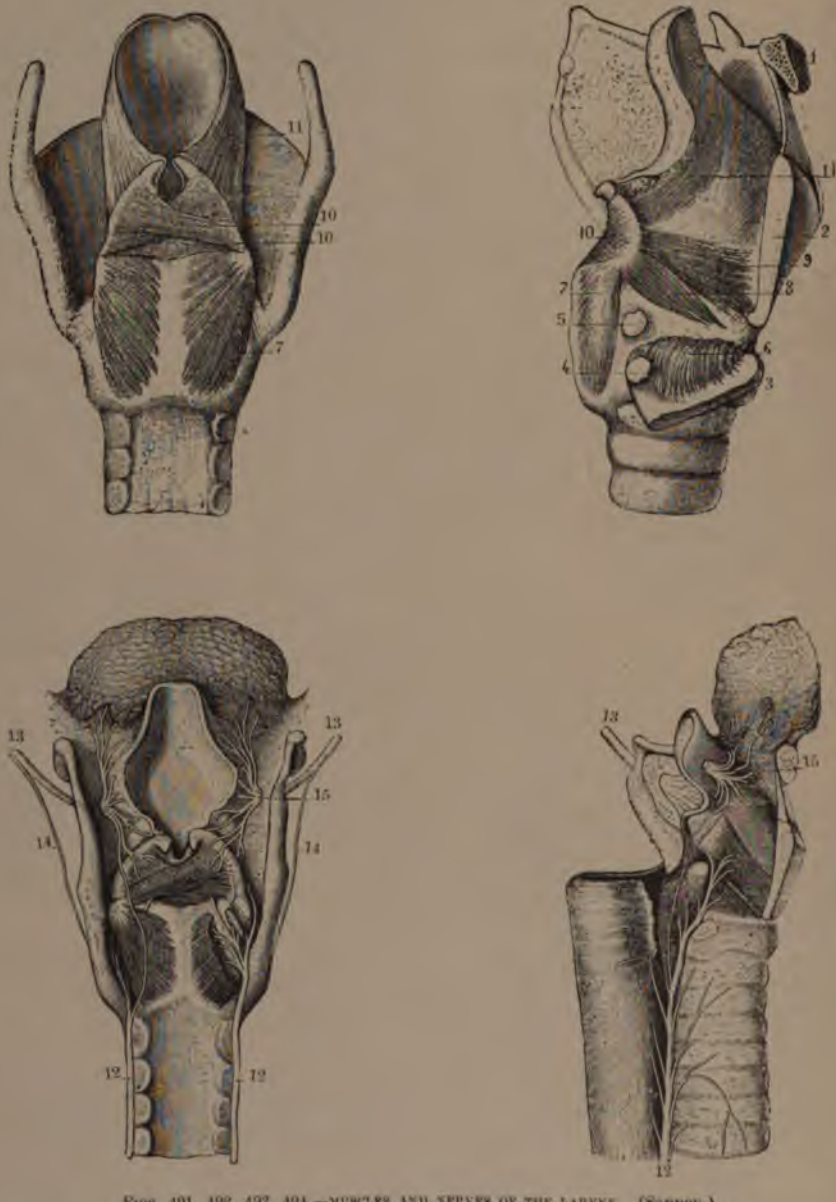
Arytæno-Epiglottideus Superior – Apex of arytænoid cartilage.
Arytæno-epiglottidean fold.
Constricts the superior aperture of the larynx during the second act of deglutition. – The oblique fibres of the arytænoideus are sometimes considered as belonging to the arytæno-epiglottidei, which muscles would then decussate in the middle line behind the horizontal fibres of the arytænoideus, or arytænoideus proper.







FIGS. 488, 489, 490.—MUSCLES OF THE LARYNX. (Gray.



FIGS. 491, 492, 493, 494.—MUSCLES AND NERVES OF THE LARYNX. (Sappey.)

1, 2, 3, 4, 5, sections of hyoid bone and thyroid cartilage, and articular facets of thyroid & cricoid cartilages; 6 7, 8, 9, 10, 11, crico-thyroideus, crico-arytenoideus posticus, crico-arytenoideus lateralis, thyro-arytenoideus, and aryteno-epiglottideus muscles; 12, 13, 14, 15, inferior or recurrent and superior laryngeal nerves, with the external and internal laryngeal branches of the latter.

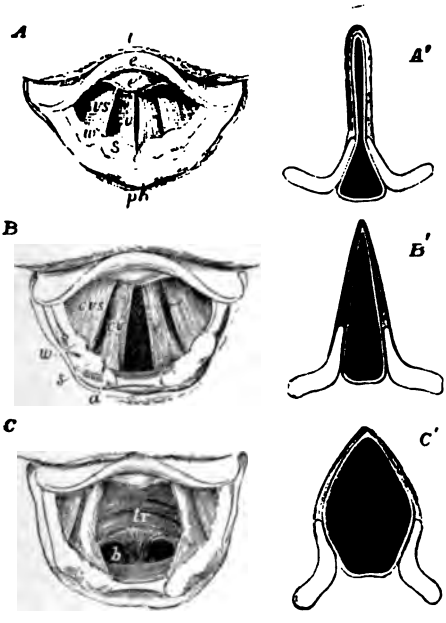


FIG. 495.—THREE LARYNGOSCOPIC VIEWS OF THE SUPERIOR APERTURE OF THE LARYNX AND SURROUNDING PARTS IN DIFFERENT STATES OF THE GLOTTIS DURING LIFE. (From Czermak.)

A, the glottis during the emission of a high note in singing. B, in easy or quiet inhalation of air. C, in the state of widest possible dilatation, as in inhaling a very deep breath. The diagrams A', B', C', have been added to Czermak's figures to show in horizontal sections of the glottis the position of the vocal ligaments and arytenoid cartilages in the three several states represented in the other figures. In all the figures, so far as marked, the letters indicate the parts as follows, viz. :—*l*, the base of the tongue; *e*, the upper free part of the epiglottis; *e'*, the posterior convex surface, tubercle, or cushion of the epiglottis; *ph*, part of the anterior wall of the pharynx behind the larynx; in the margin of the aryteno-epiglottidean fold *w*, the swelling of the membrane caused by the cuneiform cartilage; *s*, that of the corniculum; *a*, the tip of the arytenoid cartilages; *c v*, the true vocal cords or lips of the rima glottidis; *c' v'*, the superior or false vocal cords; between them the ventricle of the larynx; in C, *tr* is placed on the anterior wall of the receding trachea, and *b* indicates the commencement of the two bronchi beyond the bifurcation, which may be brought into view in this state of extreme dilatation.

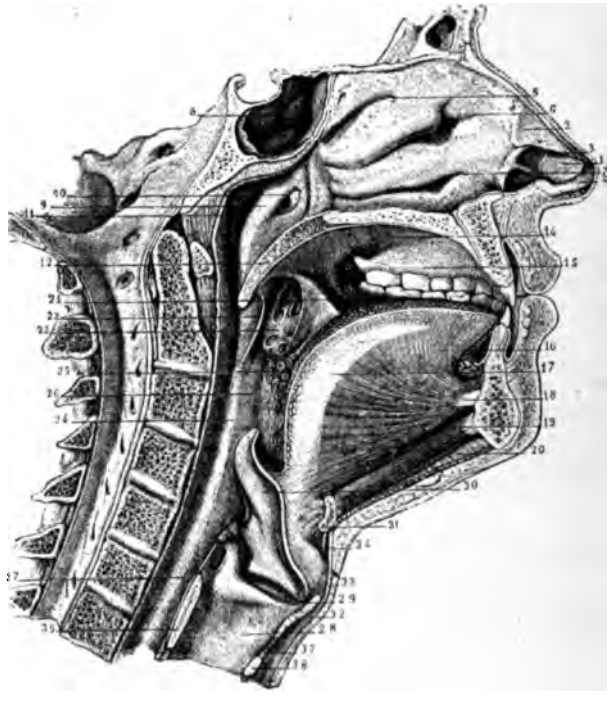


FIG. 496.—SAGITTAL SECTION THROUGH LARYNX AND SURROUNDING PARTS. (Sappey.) (See expl., p. 261a.)

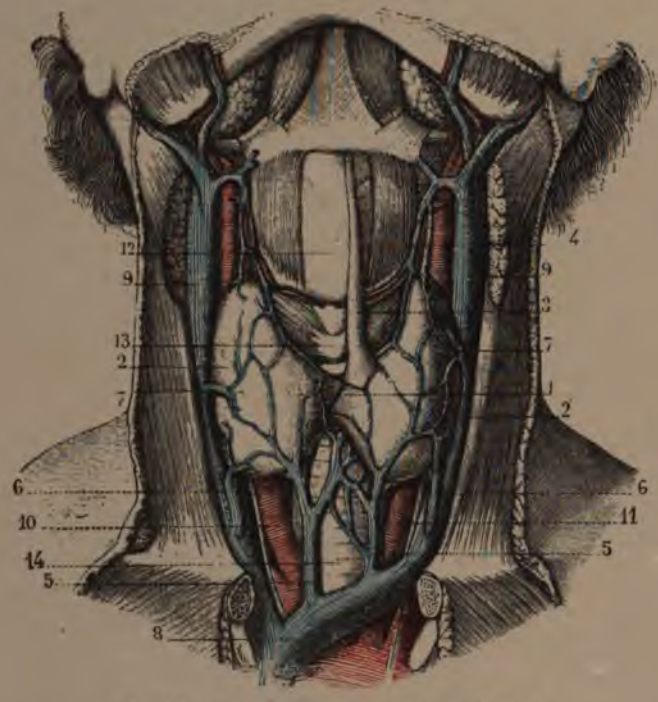


FIG. 497.—EXTERNAL RELATIONS OF LARYNX. (Sappey.)

1, 2, 3, isthmus, lateral lobes, and median process of thyroid gland; 4, 5, 6, 7, superior, inferior, and middle thyroid veins, the former with the artery of same name; 8, 9, innominate and internal jugular veins with commencement of inferior vena cava; 10, 11, the common carotid arteries: the pneumogastric nerves are seen on the outer side of the above arteries at the lower part of the neck, the right nerve crossing the subclavian artery, and the left one the arch of the aorta; 12, 13, 14, thyroid and cricoid cartilages, and trachea.

Explanation of Fig. 496.

1, 2, 3, 4, anterior aperture, and superior and inferior lateral cartilages of nose; 5, 6, 7, superior turbinated process and meatus, middle turbinated process and meatus, inferior turbinated process and meatus; 8, sphenoidal sinus; 9, 11, posterior nares; 10, opening of Eustachian tube; 12, soft palate; 14, 15, hard palate; 16, 17, tongue, with median fibrous septum; 18, 19, 20, genio-hyo-glossus, genio-hyoid, and mylo-hyoid muscles, the latter in section; 21, 22, 23, anterior and posterior pillars of soft palate and tonsil; 24, 25, 26, 27, pharnyx and glands of base of tongue; 28, 29, 30, cavity and ventricle of larynx and epiglottis; 31 to 37, sections of hyoid bone, thyroid cartilage, thyro-hyoid membrane, back and front parts of cricoid cartilage, and crico-thyroid membrane.

THE LARYNX—4th Tablet.

MUCOUS MEMBRANE

Is stretched, on entering the larynx, between the arytænoid cartilages & the epiglotti forming the *arytæno-epiglottidean folds*. These contain the thyro- & the arytænc epiglottidean muscles, the cuneiform cartilages & the cartilages of Wrisberg, and large amount of loose cellular tissue, the occasional infiltration of which tissu constitutes the so-called œdema of the glottis.

It is thin, and of a pale rosy colour. It is particularly thin & adherent over the epiglotti and still more so over the true vocal cords, where it is transparent enough for th ligamentous fibres to be seen through its substance.

Its epithelium is columnar ciliated below the superior vocal cords, and also, in front, a high as the middle of the epiglottis; above these points it loses its cilia, and gradu ally assumes the squamous form. It is squamous over the true vocal cords.

It is highly sensitive in the upper part of the larynx.

MUCOUS GLANDS — Simple tubular, and conglomerate; particularly abundant ove the posterior surface of the epiglottis, in which situation they are received into num erous small pits in the substance of the cartilage; but they are found everywher beneath the mucous membrane, excepting over the true vocal cords. The glands c the sacculus laryngis, from 60 to 70 in number, pour out their secretion upon the in ferior or true vocal cords which it is destined to lubricate. The so-called *arytænoi glands* are collected into a somewhat large mass in the arytæno-epiglottidean fold in front of the arytænoid cartilages.

VESSELS & NERVES — ARTERIES. Are the laryngeal branches of the superior inferior thyroid. – VEINS. Open into the superior, middle & inferior thyroid. – LYM PHATICS. Terminate in the deep cervical glands. – NERVES. Are the superior and th inferior or recurrent laryngeal branches of the pneumogastric, and filaments fro the sympathetic. The superior laryngeal nerve supplies the mucous membrane, th crico-thyroid muscle, & in part the arytænoid; the inferior or recurrent laryngea nerve supplies in part the arytænoid, and all the other muscles, excepting the cric thyroid.

HE LARYNX—5th Tablet.

INTERIOR of the LARYNX.

Is divided in two by the glottis or rima glottidis.

GLOTTIS or RIMA GLOTTIDIS — Antero-posterior opening comprised between the inferior or true vocal cords in its anterior three-fourths, and between the arytænoid cartilages in its posterior fourth.

In tranquil breathing it is triangular with base backwards. It is lozenge-shaped when fully dilated, as in violent inspirations. It is reduced to a narrow slit when sound is emitted; the vocal cords then lying parellel to each other, and their degree of approximation & tension increasing with the height of the sound produced.

In the adult male it is nearly an inch long, and may be dilated to nearly half an inch. In the female, and in the male before puberty, its dimensions are about one-third less.

Inferior or True Vocal Cords - Extend from near middle of receding angle of thyroid cartilage below the false vocal cords to anterior or internal angle of the base of the arytænoid cartilages. They consist of a strong band of yellow elastic fibrous tissue, the *inferior thyro-arytænoid ligament*, which band is continuous inferiorly with the lateral portion of the crico-thyroid membrane, is covered internally by a very thin & adherent layer of mucous membrane, and is strengthened externally by the thyro-arytænoid muscle.

PART ABOVE the GLOTTIS — Is broad & triangular, & presents for examination: -

Superior Aperture of the Larynx - Triangular, obliquely inclined downwards & backwards, and bounded in front by the epiglottis, & laterally by the arytæno-epiglottidean folds.

Superior or False Vocal Cords - Extend from near middle of receding angle of thyroid cartilage above the true vocal cords to the anterior surface of the arytænoid cartilages; they consist of a fold of mucous membrane containing a thin band of yellow elastic fibrous tissue, the *superior thyro-arytænoid ligament*, from which a delicate expansion extends over the sacculus laryngis. They bound superiorly the openings of the

Ventricle of the Larynx - Deep oblong saccular depression comprised between the superior & inferior vocal cords, and corresponding externally to the thyro-arytænoid muscle. It is continued superiorly & in front by a narrow opening into the

SACCULUS LARYNGIS OR LARYNGEAL POUCH - A prolongation of the foregoing, which passes upwards & forwards between the superior vocal cord & the thyroid cartilage, and is covered externally by the thyro-epiglottideus & by the thin upper fasciculus of the thyro-arytænoid, and internally by the arytæno-epiglottideus inferior or compressor sacculi laryngis. The mucous lining of the pouch is supported by an expansion from the superior vocal cord, and presents the openings of from 60 to 70 mucous glands, whose secretion lubricates the inferior vocal cords.

PART BELOW the GLOTTIS — Is flattened from side to side above, circular below, continuous inferiorly with canal of trachea.

NOTES ON THE NEWER MATTER.

THE SMALLER MUSCLES OF THE LARYNX.*

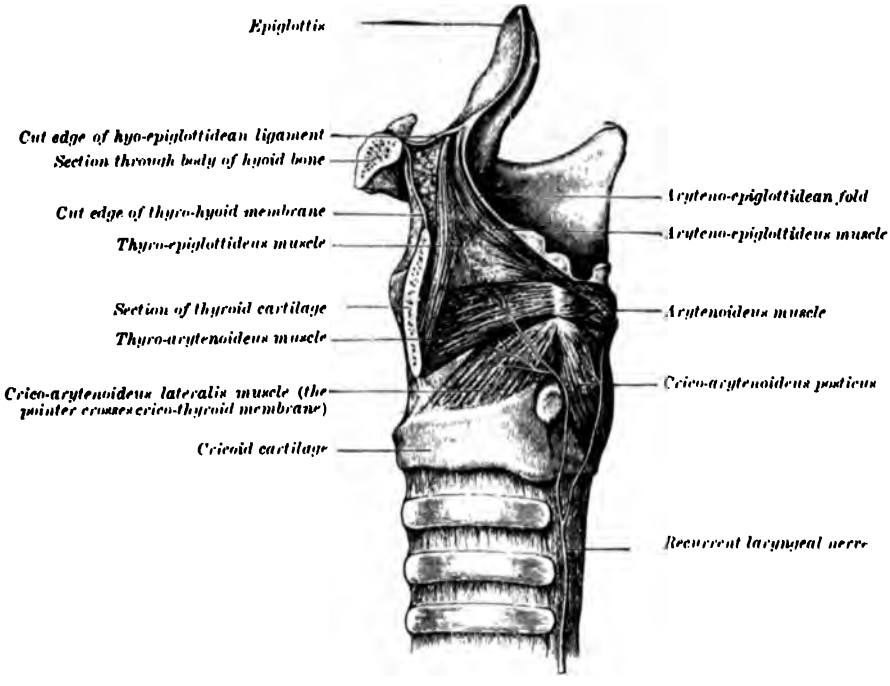


FIG. 497A. – THE DEEPER MUSCLES OF THE LARYNX. (Morris.)

Some of the fibres of the thyro-arytenoideus and of the crico-arytenoidei laterales and postici join both the horizontal and the oblique fibres of the arytenoideus.

Some of the lower fibres of the crico-arytenoideus posticus are occasionally inserted into the inferior cornu of the thyroid cartilage: these fibres constitute the *kerato-cricoideus* muscle.

Different names are given to the horizontal and to the oblique portions of the arytenoideus. The former portion is said to form the arytenoideus *transversus*. The latter is the arytenoideus obliquus, and

* The smaller muscles of the larynx supply perhaps the most telling object-lesson one could select as to the now-a-day tendencies in Anatomy,

The muscles of the larynx that everybody can see are the same in number and,

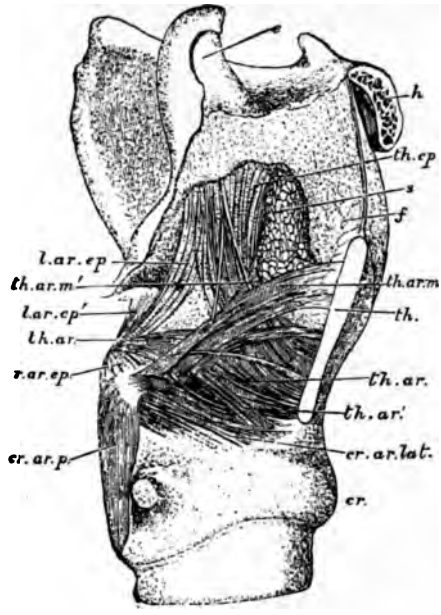


FIG. 497B.—THE DEEPER MUSCLES OF THE LARYNX. (Shattock, Quain.)

h, body of hyoid bone, cut; *e*, epiglottis; *th*, cut surface of right ala of thyroid cartilage; *cr*, front of cricoid cartilage: the articular facet for the inferior cornu of the thyroid is seen posteriorly; *th.ar*, *th.ar*, fibres of the thyro-arytenoid (outer portion) passing from the thyroid in front to the arytenoid behind; *th.ar'*, others arising from the crico-thyroid membrane; another considerable mass of fibres is seen arising from the same parts, and passing at first obliquely and afterwards nearly vertically upwards as the thyro-epiglottic muscles, *th.ep.*; *th.ar.m*, small thyro-arytenoid; *th.ar.m'*, a small slip of the same muscle passing into the false vocal cord; *cr.ar.lat*, lateral crico-arytenoid; *cr.ar.p*, posterior crico-arytenoid; *r.ar.ep*, right aryteno-epiglottic muscle near its origin; *l.ar.ep*, left aryteno-epiglottic near its insertion; *l.ar.ep'*, portion of the same inserted into the corniculum; *f*, fat; *s*, saccule covered by mucous glands.

is said to be continued into the *aryteno-epiglottideus*, - some of its fibres being prolonged beyond the arytenoid cartilages as follows :—

[*a*] The uppermost into the cartilages of Santorini: these latter fibres form the *aryteno-epiglottideus rectus* of Luschka.

[*b*] The intermediate ones run on to the inner and outer walls of the sacculus laryngis, (*a*) independently, and (*b*) in conjunction with the oblique fibres of the thyro-arytenoideus below referred to, - the conjoined fibres which reach the epiglottis forming the *thyro-ary-epiglottideus*.

[*c*] Of the lowest, some blend with the thyro-arytenoideus, others with the crico-arytenoideus lateralis.

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approximately, in size, as those of the soft palate. In either apparatus there are four distinct lateral muscles and one median - in all five, different muscles. There are no more - no more that rank and file, students and teachers, one and all, can dissect and see.

The thyro-arytenoideus is said to consist of two superposed portions, the thyro-arytenoideus externus, and the thyro-arytenoideus internus. Each portion contains antero-posterior and oblique fibres.

Of the antero-posterior fibres of the thyro-arytenoideus internus, some arise from the cartilage of Luschka contained in the anterior part of the vocal cord, and are joined by other fibres arising directly from the vocal cord, these two sets of fibres form the *ary-vocalis muscle* of Ludwig.

The oblique fibres of the thyro-arytenoideus internus pass upwards, outwards, and backwards between the antero-posterior fibres; some of these end in the ventricle of the larynx, others end in the false vocal cords.

Of the antero-posterior fibres of the outer portion nothing need be said beyond what has already been stated.

Of the oblique fibres of the thyro-arytenoideus externus—

[*a*] Some pass upwards and outwards into the aryteno-epiglottidean fold: these fibres, joining with the aryteno-epiglottidean fibres of the arytenoideus obliquus, form with it the thyro-ary-epiglottideus;

[*b*] Some wind round the sacculus laryngis, and end in the false vocal cord; and

[*c*] Some, more nearly vertical than the rest, form the principal thyro-epiglottideus muscle, a part of whose fibres join with the fibres of the thyro-ary-epiglottideus.

Santorini described three thyro-arytenoid muscles—an inferior one, a middle one, and a superior one not always present the inferior and middle thyro-arytenoid muscles of Santorini corresponding roughly to the antero-posterior and oblique fibres of the muscle as above described. The superior thyro-arytenoideus muscle of Santorini is described by Soemmering, and represented in Fig. 309 as the *small* thyro-arytenoideus, or thyro-arytenoideus minor (*th. ar. m.*). It is inserted into the base of the arytenoid cartilage. There is also another small thyro-arytenoid muscle, (*th. ar. m.'* in the figure), which passes into the false vocal cord. The two other portions of he muscle above described form the great thyro-arytenoideus muscle of Soemmering.

With just that little skill in handling knife and forceps that every man should be able to command (of what use, otherwise, is a man in our profession?) it is easy – quite easy – to make out for oneself, without any help, the muscles referred to.

But there are no more than five different muscles in either larynx, or soft palate, – or pharynx either, – that every medical man or indeed, *any* medical man who is not a throat specialist – should be expected to be personally familiar with. Except for Hilton's work, which was in the main read about, not individually repeated, the men of the two first decades referred to in "Specialism in Medical Teaching and Examining" – good dissectors they were almost to a man – roughly speaking, knew of no others.

Now-a-days, on the other hand, what are we witnessing under the influence of Specialism? In the larynx alone, there are described, as above, *some fifteen or more muscular* slips, which students are supposed – not to dissect, certainly – but, in some way or other, to learn about and give an account of.

What follows? That men learn "of, or about," as Mr. Teale well puts it – in plain English, "cram up," these *twenty* "muscles," but, *per contra*, fail very largely to even see a single one of them. They fail very largely to know anything, in the true and practical sense of knowing, of the five good big muscles which govern the production of the human voice, and also the five good big muscles, by means of which swallowing is possible without choking; one might safely add the five good big muscles by means of which one can swallow at all. Even the tongue, so often examined in our patients, are there

The superior aperture of the larynx is supposed to be closed during deglutition by the larynx being drawn up against the base of the tongue, the epiglottis being thereby - relatively to the larynx - pressed down as a lid upon the aperture. It has recently been concluded that this is really not the case: in some of the lower animals, the arytenoid cartilages appear to be drawn together and pressed against the epiglottis by the action of the arytenoid and thyro-arytenoid muscles.

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not many of us now-a-days, who know practically nothing, in the sense of having personally looked into the matter,* of what lies beneath the fur on the surface?

What is the good, then, of high talk about professional progress? Progress there is, no doubt, and wonderful progress; but not on the part of those who are in the main, and primarily, to apply it to the public good. These have, in many respects, distinctly lost ground - and lost ground through their being taught too much. There is scarcely a so-called discovery now-a-days, however crude, that is not on the first opportunity to be brought into the text-books, and then, as the idle phrase goes, "taught and examined in."

But what does it all lead to?

To cram.

Is there not here the true explanation of our loss in public esteem and confidence, of which there are everywhere so many signs? We are noticing "the lowering on a large scale," says the *Lancet*, of "the public estimate of medical science and service."

Do not blame either students or practitioners. They are as good and true men as ever. It is the Specialism that is crushing the life out of them.

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* "*Numbers who dissect dwindling to a minimum*;" "*dissections of the deeper parts seldom made by the student now.*"—Leading articles in LANCET for Jan. 20th, 1894, and Feb. 6th, 1897.

THORAX.

I.

INNOMINATE VS. & SUP. VENA CAVA.

INNOMINATE VEINS — Two large trunks formed by junction of internal jugular & subclavian behind corresponding sterno-clavicular articulation

RIGHT INNOMINATE — An inch & a half long, some what smaller than the left, and nearly vertical. Lies superficial & external to innominate artery and is separated externally from right lung by right phrenic nerve & pleura. Joins with left innominate just below cartilage of 1st rib to form superior cava. Receives

Right Lymphatic Duct – At its origin, in angle of junction between right subclavian vein & right internal jugular.

Tributary Branches: – *Right Vertebral, Internal Mammary, Inferior Thyroid, & Superior Intercostal*

LEFT INNOMINATE — Three inches long, & somewhat larger than the right. Descends obliquely from behind left sterno-clavicular articulation to just below 1st costal cartilage of right side, lying in front of innominate, left common carotid & subclavian arteries, and behind sterno-hyoid & -thyroid muscles, remains of thymus gland, & sternum. Receives

Thoracic Duct – At its origin, in angle of junction between left subclavian vein & left internal jugular

Tributary Branches: *Left Vertebral, Internal Mammary, Inferior Thyroid, Superior Intercostal,* and sometimes some small *Thymic & Pericardiac Veins.* – The innominate veins have no valves

SUPERIOR VENA CAVA — Short thick trunk (2½ to 3 inches long), slightly curved & convex to the right. Descends vertically along right side of ascending portion of arch of aorta & in front of root of right lung from just below 1st costal cartilage of right side, enters fibrous bag of pericardium about an inch and a half above the heart, becomes invested anteriorly by serous layer on the same bag, and opens into upper & front part of right auricle; is separated externally from right lung by right phrenic nerve & pleura, and its anterior relations are the same as those of the innominate. – Receives

Tributary Branches: – *Vena Azygos Major,* and some small *Pericardiac & Mediastinal Veins.* – Has no valves

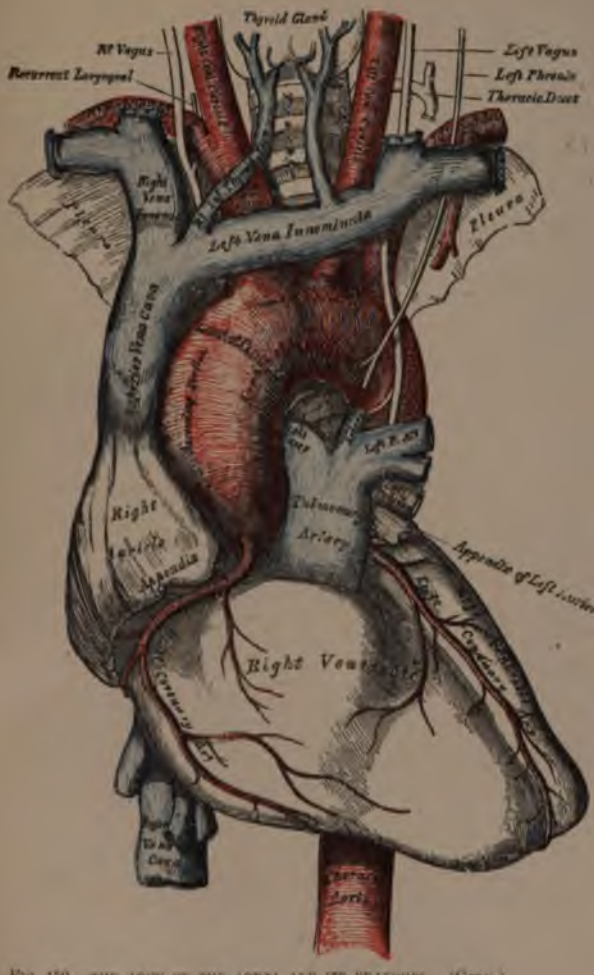

FIG. 450.—THE ARCH OF THE AORTA AND ITS BRANCHES. (Gray.)

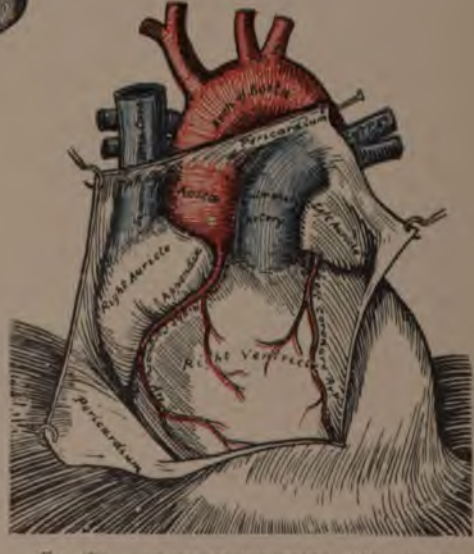

FIG. 450A.—THE PERICARDIUM OPENED. (After Testut.)

Fig. 451.—The superficial, deep, and superior epigastric, and internal mammary arteries. (Sappey.)

Fig. 452.—The deep and superior epigastric, and internal mammary arteries. (Quain.)

INTERNAL MAMMARY ARTERY.

From under surface of subclavian, opposite thyroid axis.

Downwards behind phrenic nerve and internal jugular & subclavian veins to
terior aspect of costal cartilages a short distance from ster

Descends between thoracic wall & pleura, giving off branches: –

Perforating, Anterior Intercostal, Anterior Mediastinal, & Comes Nervi Phr

and divides between 6th & 7th costal cartilages & beneath triangularis s
into branc

Musculo-phrenic, & Superior Epigastric.

Its two venæ comites unite into one trunk before they open into the innominate.

PERFORATING – Forwards through five or six upper intercostal spaces to pectoralis m
integument, and ma

ANTERIOR INTERCOSTAL —— Outwards in five or six upper intercostal spaces bet
internal intercostal muscles & pleura, and divide between internal
ternal intercostal muscles into superior & inferior branches which inc
late with corresponding branches of corresponding aortic intercos
and are similarly distribu

ANTERIOR MEDIASTINAL – Small, irregular; to pericardium, remains of thymus gla
cellular tissue of anterior mediastin

COMES NERVI PHRENICI (SUPERIOR PHRENIC) – From upper part of artery. Long, slen
with phrenic nerve to diaphragm, and anastomose with musculo-phre
& inferior phrenic from abdominal a

MUSCULO-PHRENIC – Downwards & outwards behind cartilages of false ribs, supply
diaphragm which it perforates opposite 8th or 9th rib, & abdom
muscles, and giving off a small anterior intercostal branch to each of
lower intercostal spa

SUPERIOR EPIGASTRIC – Enters sheath of rectus posteriorly, and anastomoses with
gastric branch of external iliac, lower intercostal & lumbar; gives tw
to rectus & to integument of middle line of abdon

THE PERICARDIUM.

Fibro-serous sac containing the heart & the commencement of the large vessels.

The serous layer forms a common sheath to the aorta & pulmonary artery as far as about two inches from their origin. It is then reflected upon the anterior aspect of the venæ cavæ & pulmonary veins, and upon the inner surface of the fibrous layer. – Marshall's "vestigial fold of the pericardium" containing the remains of the left superior cardinal vein of the embryo, may be seen in front of the root of the left lung.

The fibrous layer is prolonged upon the great vessels of the root of the neck, and becomes continous superiorly with the deep layer of the deep cervical fascia, that is to say with the layer of fascia which encloses the omo-hyoid muscles, the carotid vessels, & the trachea.

The pericardium is conical in shape, and presents : –

Anterior Aspect – Covered by loose areolar tissue & remains of thymus gland, lungs, pleuræ, middle piece of sternum, and costal cartilages of the left side from the 3rd to the 7th.

Posterior Aspect – In contact with roots of the lungs, œsophagus & descending aorta.

Lateral Aspects – Covered by pleuræ, and crossed by phrenic nerve & superior phrenic vessels.

Apex - Directed upwards upon great vessels.

Base - Attached to central or cordiform tendon, & to left anterior costal fibres of diaphragm.

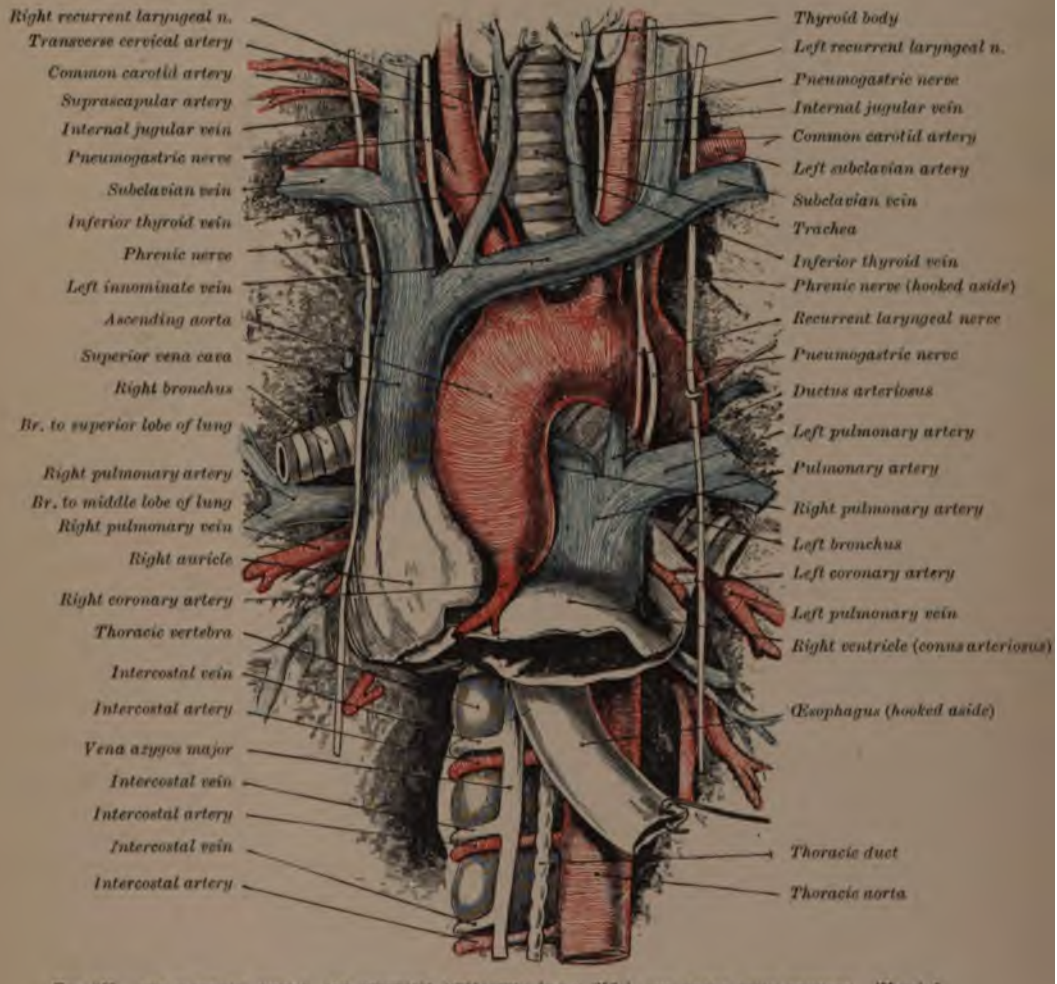

FIG. 453.—THE SUPERIOR, MIDDLE, AND POSTERIOR MEDIASTINA (see p. 256a), THE HEART BEING REMOVED. (MORRIS.)

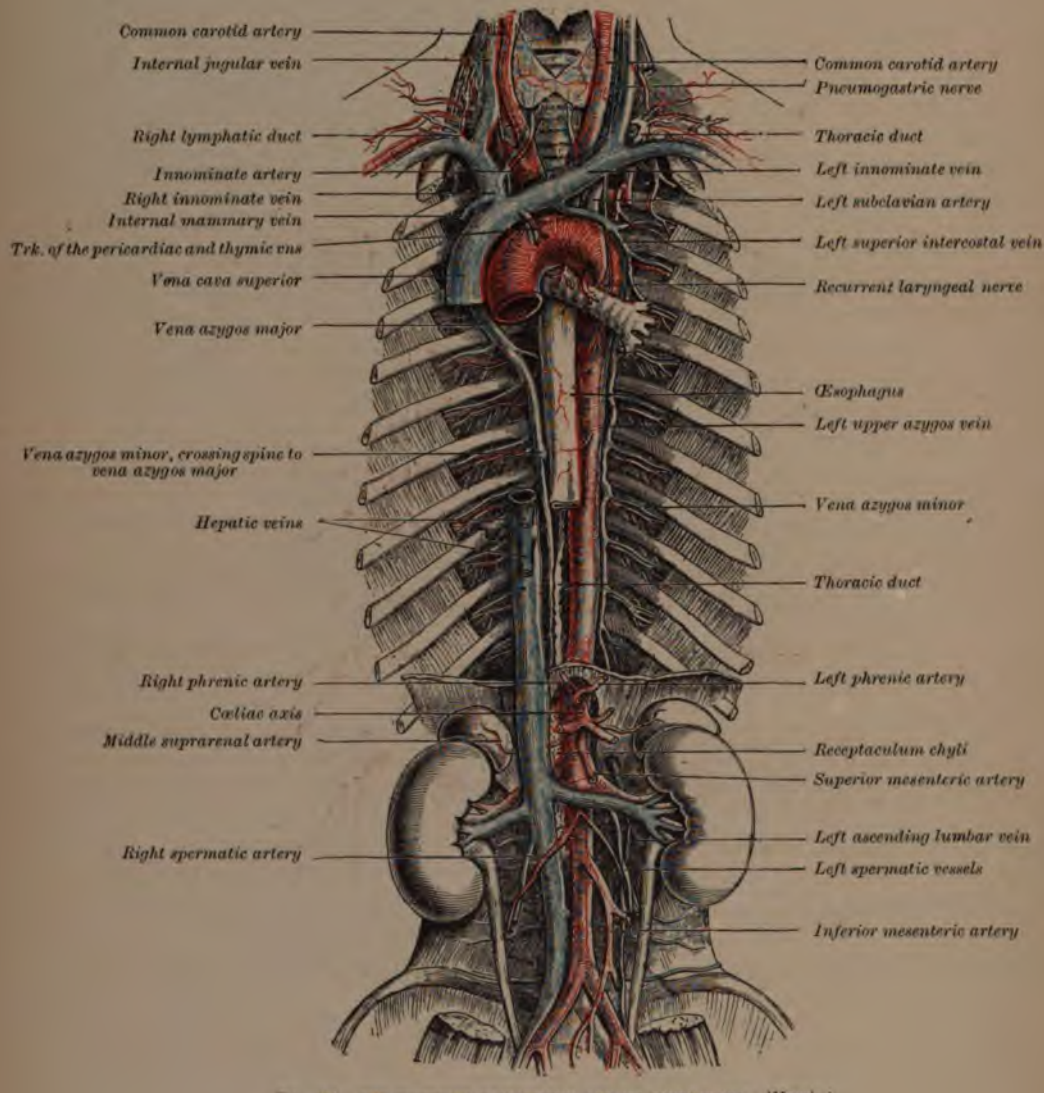

FIG. 454.—THE POSTERIOR MEDIASTINUM AND ITS CONNECTIONS. (Morris.)

THE HEART.

Lies within the pericardium, between the two lungs, behind the lower two-thirds of th sternum, and projects about three inches into the left side, & one into the right sid of the thorax. – It presents

Base – Formed by the auricles, attached to the great vessels, directed upwards backwards & to the right; corresponds to the interval between the 5th & 8th dorsal vertebra

Apex – Formed by the point of the left ventricle, directed downwards, forwards & to the left corresponds to the 5th intercostal space of the left side, three and a half inches to th left of the median line

Anterior Surface – Formed chiefly by right ventricle, the anterior interventricular groove lying near the left border; convex, looks upwards & forwards, and extends from level of upper borders of third costal cartilages to a line drawn from lower end o gladiolus to situation of apex

Posterior Surface – Formed chiefly by left ventricle, the posterior interventricular groove lying near the right border; flattened; rests upon diaphragm.

Right Border – Long, thin, rests upon diaphragm; formed by right ventricle.

Left Border – Short thick, much less inclined than the right one; formed by left ventricle.

THE ARCH of the AORTA.

From upper part of left ventricle to left side of lower border of body of 5th* dorsal vertebra, describing a curve, the convexity of which is directed upwards & to the right Is divided into: –

ASCENDING PORTION — About two inches long. Upwards, forwards, & to the right from opposite left side of sternum on a level with lower border of 3rd costal cartilages to upper border of 2nd costal cartilage of right side close to sternum. Contained in pericardium together with trunk of pulmonary artery. – RELATIONS:

IN FRONT – Pulmonary artery, right auricular appendix, pericardium, loose areolar tissue, remains of thymus gland, sternum.

BEHIND – Right pulmonary vessels, & root of right lung.

TO THE RIGHT – Superior vena cava, right auricle.

TO THE LEFT – Trunk of pulmonary artery.

TRANSVERSE PORTION — Backwards & to the left from upper border of 2nd costal cartilage of right side close to sternum to left side of 4th dorsal vertebra. – RELATIONS:

IN FRONT – Left pneumogastric & phrenic nerves, cardiac branches of sympathetic, left lung & pleura.

BEHIND – Trachea, œsophagus, thoracic duct, left recurrent laryngeal nerve, great or deep cardiac plexus.

ABOVE – Left innominate vein, innominate, left common carotid, & left subclavian arteries.

BELOW – Left bronchus, right pulmonary artery, left recurrent laryngeal nerve, remains of ductus arteriosus.

DESCENDING PORTION — Along left side of 4th & 5th to lower border of 5th* dorsal vertebræ, where it becomes thoracic aorta. – RELATIONS:

IN FRONT – Pleura, left bronchus.

BEHIND – Bodies of 4th and 5th dorsal vertebræ.

TO THE RIGHT – Œsophagus, thoracic duct.

TO THE LEFT – Left lung & pleura.

The aorta is somewhat dilated just above its origin, where it presents externally three small bulgings corresponding to the sinuses of Valsalva; one of these bulgings is anterior, and two are posterior; and from the anterior and left ones the coronary arteries are seen to arise. The most prominent part of the arch lies about ¼ of an inch behind the posterior surface of the sternum. The height to which the arch usually rises in the chest is about 1 inch below the upper border of the sternum.

BRANCHES — **Left or Anterior, & Right or Posterior Coronary, Innominate, Left Common Carotid, Left Subclavian.**

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* Up to a few years ago there was accord between all the anatomists the author knows of (human dissectional anatomists, both British and Foreign) as to arch of the aorta presenting ascending, transverse, and descending portions, the latter limited by none, whether or not described separately (Cruveilhier, Sappey), at a point higher than the left bronchus. *For the description introduced since embryology has been made one of the bases of anatomy, see page* 256j. It will be seen, – though this may not strike one at once, – that this description *suppresses* the descending portion of the arch of the aorta as formerly described, and joins this portion of aorta to the Thoracic aorta. The departure – though evidently one that should not be overlooked – is liable not to be noticed at first sight, for the reason that all the levels of the thoracic viscera being now lowered by one vertebra, the arch of the aorta, *short of its descending portion*, still comes to end, as formerly stated, opposite the fourth dorsal vertebra. Making the necessary correction as to the above lowering of the thoracic levels, the arch of the aorta as hitherto described – *that is including its descending portion* – must now be taken as ending opposite the *fifth* dorsal vertebra.

It will be seen that to transform the dissectional into the "scientific" description, one has simply to ignore the last of the three paragraphs given above, to call the ascending portion of the aorta the "Ascending aorta," and the transverse portion the "Arch," and, as a necessary consequence, to include *the left bronchus* among the anterior relations of the Thoracic aorta, *which must* THEN *be made to begin opposite the lower border of the* FOURTH dorsal vertebra.

THE THORACIC AORTA.

Commences at left side of lower border of 5th* dorsal vertebra. Descends through posteri mediastinum, curving slightly forwards and inclining slightly to the right, and ends at aort opening of diaphragm in front of 12th dorsal vertebra. – RELATION

IN FRONT – Pulmonary vessels, pericardium, œsophagus.
BEHIND – Vertebræ, vena azygos minor.
TO THE RIGHT – Œsophagus (above), vena azygos major, thoracic duc
TO THE LEFT – Left lung & pleura. œsophagus (below).

BRANCHES:

Pericardiac – Small, irregular; forwards to pericardium.

Bronchial – The nutrient vessels of the lungs. On left side, generally two arisi from thoracic aorta one above the other; on right side, but one usua arising either from first aortic intercostal, or from front of aorta in comm with artery of left side. Along back of corresponding bronchus, dividing subdividing upon bronchial tubes, and supplying bronchial glands & cellu tissue of lung; give a few twigs to œsophag

Œsophageal – Usually four or five from front of aorta. Descend obliquely upon œsopl gus anastomosing with each other, and with the œsophageal branch of the inferior thyroid, inferior phrenic & gastr

Posterior Mediastinal – Small irregular branches to glands and cellular tissue mediastinu

Aortic Intercostals – From back of aorta. Usually ten in number, sometimes o nine, the second intercostal space being sometimes supplied, as well as t first, by the superior intercostal branch of the subclavian. To corr ponding intercostal space, passing

LEFT SIDE – Beneath smaller azygos & left superior intercostal vei and left cord of sympathet

RIGHT SIDE – Round bodies of vertebræ beneath œsophagus, thora duct, greater azygos, & right cord of sympathetic, – and divi into anterior & posterior branch

ANTERIOR BRANCH, OR INTERCOSTAL PROPER – Upon external intercostal muscle a beneath pleura & a thin layer of fascia, to lower border of rib above, a divides between the two intercostal muscles into branche

Superior – The larger; along groove on inner surface of rib above;
Inferior – The smaller; along upper border of rib below, – which branch supply intercostal muscles, and anastomose with thoracic branches axillary & anterior intercostal branches of internal mammary.

The three last intercostals are prolonged between abdominal muscl and anastomose with epigastric, inferior phrenic & lumbar; the first o anastomoses with superior intercostal. – In the intercostal spaces the ve usually lies above the trunk of the artery & its superior branch, and t nerve belo

POSTERIOR OR DORSAL BRANCH – Backwards on inner side of superior or long cost transverse ligament with posterior branch of corresponding spinal nerv and divides into branche

Spinal – Through intervertebral foramen to cord & its membranes and po terior aspect of bodies of vertebr

Muscular – Divides into *internal offset* to multifidus spinæ & integument ne spine, and *external offset*, which passes between sacro-lumbalis longissimus dorsi to superficial muscles & integumen

* See foot-note to page 234.

INNOMINATE ARTERY.

From commencement of horizontal portion of arch of Aorta in front of left common carotid.
Upwards & to the right to upper border of right sterno-clavicular articulation, where divides into right common carotid & right subclavian.
Gives off occasionally the thyroidea ima. Its length is usually from an inch to an inch & a half.—RELATIONS:

In Front — Sternum, sterno-hyoid & -thyroid, remains of thymus gland; Left innominate & right inferior thyroid veins; Inf. cervical cardiac br. of right pneumogastric.
Behind — Trachea.
On Inner Side — Left common carotid, remains of thymus gland.
On Outer Side — Right pneumogastric n., right innominate vein, pleura.

Thyroidea Ima — Is very variable in size, when present. Usually arises from innominate, sometimes from right common carotid or from Aorta. Ascends in front of trachea to thyroid gland.

COMMON CAROTID ARTERY.

Right common carotid arises from innominate artery behind sterno-clavicular articulation.
Left common carotid arises from highest part of arch of Aorta, is longer, and has a thoracic portion deeply situated within the thorax.

THORACIC PORTION OF THE LEFT COMMON CAROTID ART.

Upwards & outwards to root of neck. — RELATIONS:

In Front — Sternum, sterno-hyoid & -thyroid, left innominate v., remains of thymus gland.
Behind — Trachea, œsophagus, thoracic duct.
On Inner Side — Innominate artery.
On Outer Side — Left pneumogastric & phrenic ns. & left subclavian art., left lung & pleura.

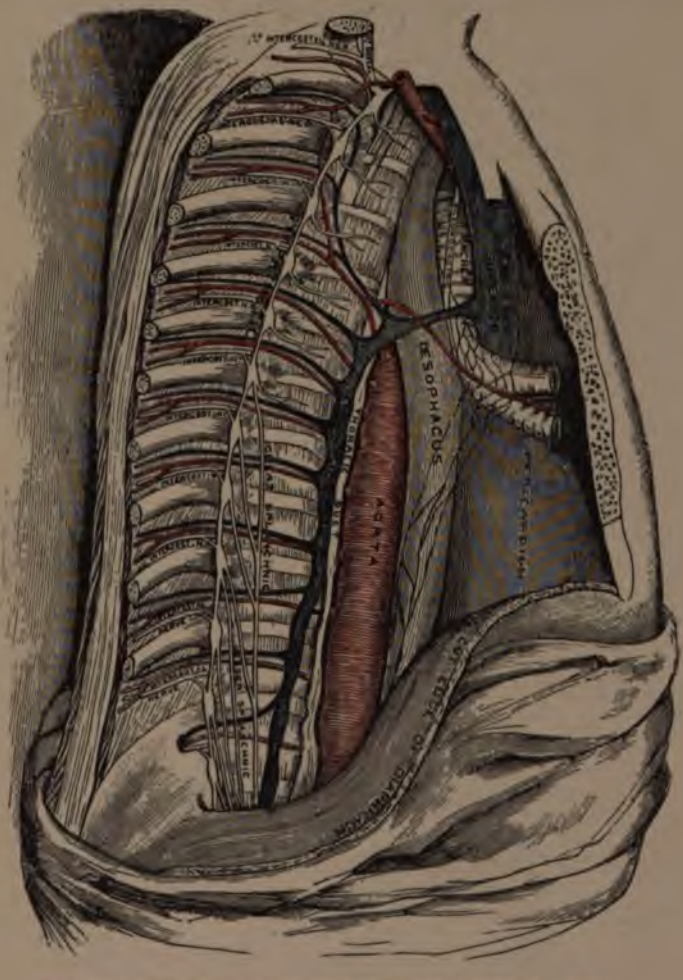


FIG. 455.—THE POSTERIOR MEDIASTINUM AS SEEN FROM THE SIDE. (Gray.)

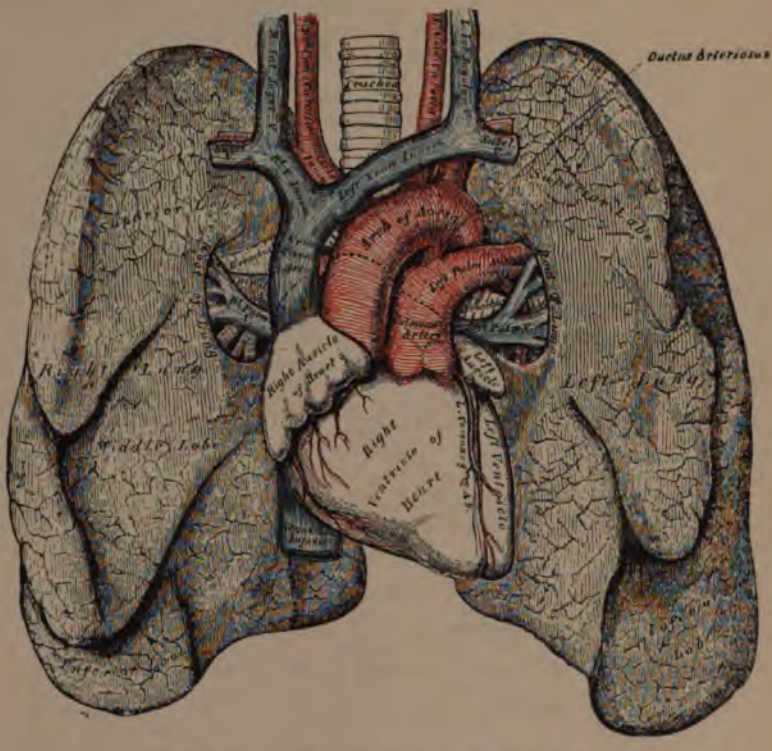


FIG. 456.—FRONT VIEW OF THE HEART AND LUNGS. (Gray.)

FIG. 457.—OPENINGS AND BOUNDARIES OF THE HEART. (Gray.)

1, Pulmonary opening; 2, aortic opening; 3, left auriculo-ventricular opening; 4, right auriculo-ventricular opening.

SUBCLAVIAN ARTERY.

From innominate artery behind upper border of sterno-clavicular articulation (right si
from end of transverse portion of arch of Aorta (left side), to outer border of first
Divided into three part

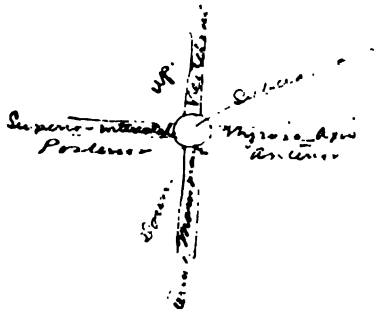
FIRST PART — From origin to inner border of scalenus anticus. Differs on the two sides.

RIGHT SIDE — Arches upwards & outwards across root of neck, and is shorter & n
superficial than on left side – RELATIO
In Front – Sterno-clavicular articulation, sterno-mastoid, -hyoid, & -thyroid, d
layer of fascia; – and the artery is crossed
Internal & anterior jugular and vertebral veins, pneumogastri
phrenic nerves, and cardiac branches of sympathe
Behind – Longus colli, transverse process of 7th cervical vertebra, cord of s
pathetic, recurrent laryngeal ne
Below – Pleura.

SUBCLAVIAN VEIN lies below & in front of artery immediately behind clavi

LEFT SIDE — Ascend: nearly vertically, and is longer & more deeply situated. – RELATIO
In Front – Same, plus left lung & pleura, left innominate v., left com. carotid; –
Pneumogastric & phrenic nerves & cardiac branches of sympat
tic are nearly parellel to the art
Behind – Same, plus œsophagus & thoracic duct.
On Inner S.–Trachea, œsophagus, thoracic duct, left common carotid artery.
On Outer S.– Pleura.

BRANCHES — Vertebral, Internal Mammary, Thyroid Axis – A
close together near inner border of scalenus anticus,
interval measuring usually from ½ an inch to 1 inch being
between the origin of the artery & its first branch. On
left side the **Superior Intercostal** also usually ar
from this part of the art



PNEUMOGASTRIC NERVE.

Arises from groove between olivary & restiform bodies below glosso-pharyngeal & above spinal accessory.

Through jugular foramen behind glosso-pharyngeal & in same sheath as spinal accessory.
Presents two ganglia, one in and one below jugular foramen:

SUP. OR JUGULAR G. OR G. OF THE ROOT — Small, greyish, rounded. Anastom. with *facial, glosso-pharyngeal, spinal accessory & sympathetic.*

INF. G. OR G. OF THE TRUNK — Reddish, cylindrical, nearly an inch in length. Anastom. with *hypoglossal, spinal accessory, sympathetic, loop between two first cervical nerves*

Descends behind & between int. & comm. carotid arteries & int. jugular v. and in same sheath;
Then,

ON RIGHT SIDE:
Between subclavian art. & v. and along side of trachea to back of root of lung, where spreads out into posterior pulmonary plexus.
Along side of œsophagus in the shape of two or more separate cords, which form œsophageal plexus with nerve of opposite side.
As a single cord along back of œsophagus to posterior surface of stomach, and joins solar & splenic plexuses.

ON LEFT SIDE:
Between and in front of left comm. carotid & left subclavian arteries behind left innominate vein.
Across arch of aorta to back of root of lung, where similarly spreads out and joins with its fellow.
Along side of œsophagus as above.
As a single cord along front of œsophagus to anterior surface of stomach, and joins left hepatic plexus.

BRANCHES:

Auricular Br. — Arises from g. of the root, and joins with glosso-pharyngeal.
Across jugular fossa & through opening in temporal bone near styloid process;
Between mastoid process & ext. audit. meatus to integument of back of pinna.
Gives off:
ASCENDING BR., which joins trunk of facial in aqueductus Fallopii;
DESCENDING BR., which joins auricular branch of facial.

Pharyngeal Br. — Arises from upper part of ganglion of the trunk;
Crosses internal carotid art. either in front or behind;
Anast. with glosso-pharyngeal, sup. laryngeal & sympathetic, and forms pharyngeal plexus to muscles & mucous membrane of pharynx.

Sup. Laryngeal N. — Arises from middle of ganglion of the trunk.
Descends by side of pharynx behind int. carotid artery, and divides into:
EXT. LARYNGEAL BR. — Joins with pharyngeal plexus & sup. cardiac nerve, and supplies crico-thyroid & inf. constrictor.
INT. LARYNGEAL BR. — Pierces thyro-hyoid membrane to arytenoid muscle and mucous membrane of larynx, base of tongue & aryteno-epiglottidean folds.

Recurr. Laryngeal N. — Ar. in front of, and passes below & behind, subclav. art. on right side, arch of aorta, on left, giving twigs to deep cardiac plexus;
Behind comm. carotid & inf. thyroid arteries, and in groove between trachea & œsophagus.
Beneath int. constrictor to all the muscles of the larynx except crico-thyroid.
Gives brs. to inf. constrictor, and anastomoses with ext. laryngeal

Cardiac Brs. — Divided into:
CERVICAL CARDIAC } Vide Nerves of the Heart.
THORACIC CARDIAC }

Pulmonary Brs. — Divided into ANTERIOR and POSTERIOR, and form the ant. & post. pulmonary plexuses. (Vide nerves of the lung.)

Œsophageal Brs. — Arise, some above, but most of them below, the pulmonary.

Gastric Brs. — Right pneumogastric supplies post. aspect of stomach and joins solar & splenic plexuses; left pneumog. supplies ant. aspect, and joins left hepatic plexus.

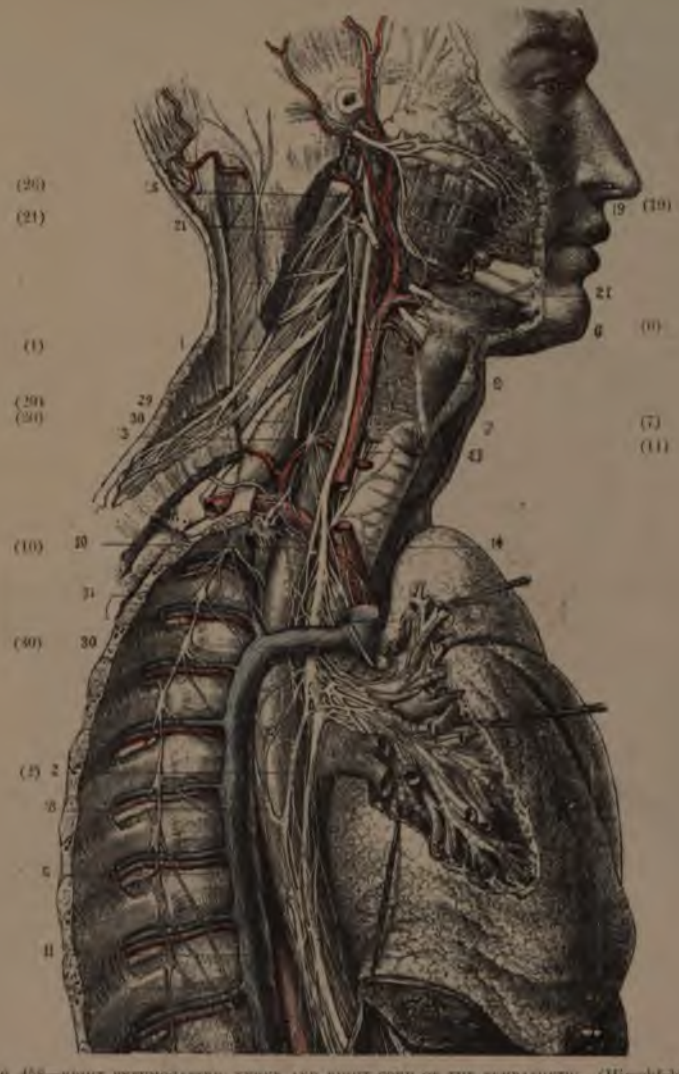


FIG. 458.—RIGHT PNEUMOGASTRIC NERVE AND RIGHT CORD OF THE SYMPATHETIC. (Hirschfeld.)

(1, 2) **Cervical and thoracic portions of the right pneumogastric nerve.**

(6,7) **Superior laryngeal nerve** and its **external laryngeal branch**, the latter supplying the crico-thyroid.

(10, 11) **Inferior or recurrent laryngeal**, first winding round the first portion of the subclavian artery, and then entering the larynx beneath the inferior constrictor.

(23, 13) **Superior & middle cervical ganglia** of the sympathetic.

(12) **Inferior cervical ganglion**, deeply situated between the neck of the first rib and the transverse process of the last cervical vertebra;

31, thoracic ganglia;

9 & 14, superior & inferior cardiac branches of the pneumogastric;

16, posterior pulmonary plexus.

18, œsophageal plexus.

(19) **Glosso-pharyngeal nerve.**

(21) **Hypoglossal nerve**, divided.

(26 & 29) Spinal portion of the **spinal accessory nerve**: 30, 30, phrenic nerve, descending in front of scalenus anticus and in front of the root of the lung.

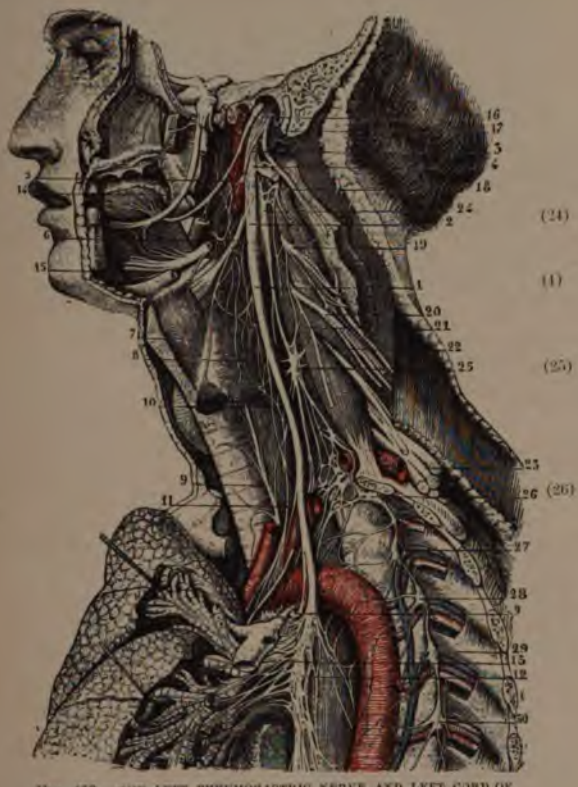


Fig. 459.—THE LEFT PNEUMOGASTRIC NERVE AND LEFT CORD OF THE SYMPATHETIC. (Sappey, Hirschfeld.) See p. 166c.

1, pneumogastric n.; 24, 25, 26, the three cervical ganglia of the sympathetic.

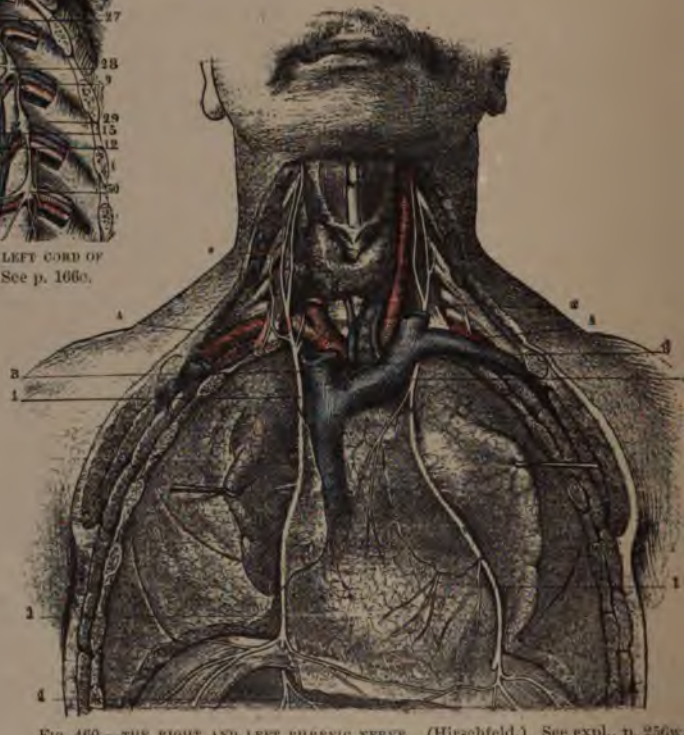


Fig. 460.—THE RIGHT AND LEFT PHRENIC NERVE. (Hirschfeld.) See expl., p. 256w

PHRENIC NERVE.

Phrenic or Int. Respiratory of Sir C. Bell – From 3rd, 4th, and usually also from 5th (cervical ns.
Downwards & inwards in front of scalenus anticus.
Between subclavian vein & 1st part of subclavian artery crossing internal mammary, and receiving a filament from sympathetic, sometimes another from 5th & 6th cervical nerves, and occasionally on the left side, one from the ansa hypoglossi.
Crosses arch of Aorta & pulmonary artery, on the left side.
Descends, on the right side, on outer side of right innominate vein & sup. vena cava.
In front of root of lung & along side of pericardium to diaphragm, and divides in to branches which perforate the diaphragm and supply it by its under surface.
Both nerves give off twigs to the pericardium & pleura, and join with the phrenic plexus of the sympathetic, the right nerve sending also a few filaments to the diaphragmatic ganglion.

CORONARY or CARDIAC VESSELS.

CORONARY OR CARDIAC ARTERIES — Two. From upper part of the bulgings corresponding to the two anterior sinuses of Valsalva just above free margin of semi-lunar valves.

Left or Anterior - The smaller. Forwards & to the left between pulmonary artery & left auricular appendix, and divides into branches:

HORIZONTAL - The smaller; along left auriculo-ventricular groove, and joins with horizontal branch of right or posterior coronary.

DESCENDING - The larger; along anterior interventricular groove to apex of heart, where it joins with descending branch of right or posterior coronary.

Right or Posterior - The larger. Forwards & to the right between pulmonary artery & right auricular appendix, and then backwards along right auriculo-ventricular groove, sending a large branch down right border of heart, and divides into branches:

HORIZONTAL - The smaller; along left auriculo-ventricular groove, and joins with horizontal branch of left or anterior coronary.

DESCENDING - The larger; along posterior interventricular groove to apex of heart, where it joins with descending branch of left or anterior coronary.

CORONARY OR CARDIAC VEINS.

Great Cardiac Vein - Ascends from apex of heart along anterior interventricular groove, turns backwards along left auriculo-ventricular groove, receiving an ascending branch of some size from left border of heart, and opens into left extremity of the coronary sinus, its opening being guarded by two valves.

Posterior Cardiac Vein - Ascends from apex of heart, where it communicates with preceding, along posterior interventricular groove, and opens into right extremity of coronary sinus, its opening being guarded by a valve. It receives the veins from the posterior surface of both ventricles.

Coronary Sinus - Thick trunk about an inch long situated at back part of left auriculo-ventricular groove, and partly covered & concealed by muscular fibres of left auricle. It receives the great & posterior cardiac veins, and a small vein, the remnant of the left superior cardinal vein of the embryo (Marshall), which passes downwards & to the right along back part of left auricle. It opens into the lower & back part of the right auricle close to the septum, below the opening of the inferior vena cava & Eustachian valve. Its opening is guarded by the valve of Thebesius.

Small or Anterior Cardiac Veins & Venæ Cordis Minimæ - Several small branches, which collect the blood from the anterior surface of the right ventricle, and from the muscular substance of the heart, and which open separately into the lower part of the right auricle (foramina Thebesii); one, larger than the others, runs along the right border of the heart.

THORAX.

II.

PULMONARY VESSELS.

PULMONARY ARTERY.

Short thick trunk about two inches long, which conveys the venous blood from the right side of the heart to the lungs.

Arises from apex of infundibulum of right ventricle opposite upper border of 3rd costal cartilage of left side close to sternum.

Upwards, backwards & to the left, winding spirally in front & then to the left of ascending portion of arch of aorta, the two vessels being contained in one tubular sheath of the serous layer of the pericardium. – On either side of the artery are the auricular appendices & the coronary arteries; behind it are the aorta & the left auricle.

Pierces fibrous layer of pericardium, and divides below & in front of transverse portion of arch of aorta into: –

Right Pulmonary Artery – The larger & longer. To the right behind ascending aorta & superior vena cava to root of right lung, in which it lies, both from before backwards and from above downwards, between the pulmonary veins & the bronchus. Divides into:

SUPERIOR BRANCH – The smaller, to superior & middle lobes.
INFERIOR BRANCH – The larger, to inferior lobe.

Left Pulmonary Artery – The smaller & shorter, connected at its root by remains of ductus arteriosus to under surface of arch of aorta. To the left in front of descending aorta, lying, in root of left lung, above the veins & the bronchus, but behind the former & in front of the latter. Divides into:

SUPERIOR BRANCH – The smaller, to superior lobe.
INFERIOR BRANCH – The larger, to inferior lobe.

PULMONARY VEINS.

Usually four. Commence upon the intercellular passages & air-cells in the capillary network of the pulmonary artery, but are also continuous with some of the terminal ramifications of the bronchial arteries.

Their smaller divisions are but very little larger than the corresponding branches of the pulmonary artery, and they accompany these singly, and form a single trunk for each lobule.

Their larger branches are destitute of valves, and form a single trunk for each lobe, the trunk from the middle lobe of the right lung uniting with that from the upper.

The two trunks from right lung pass behind superior vena cava, right auricle & ascending aorta, and those from left lung cross anteriorly the descending aorta; all are invested anteriorly by serous layer of pericardium.

In the lung the pulmonary vessels are generally found to lie in front of the corresponding bronchial tubes, the artery being above the vein. In the roots of the lungs the pulmonary veins lie in front of the arteries, and the arteries in front of the bronchus; and the order from below upwards is *veins, artery, bronchus*, on the right side, *veins, bronchus, artery*, on the left. There is sometimes a small distinct vein for middle lobe of right lung. The two left pulmonary veins often unite into one trunk.

Pulmonary Veins – 3 on right side 2 on left
Bronchial " – 2 " " " 3 "

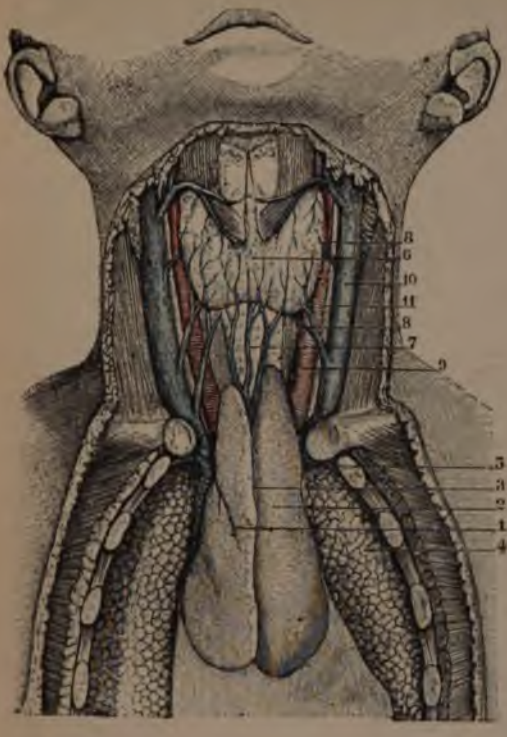


FIG. 461.—THE THYROID AND THYMUS GLANDS IN THE CHILD. (Sappey.)
(See expl., p 228n.)

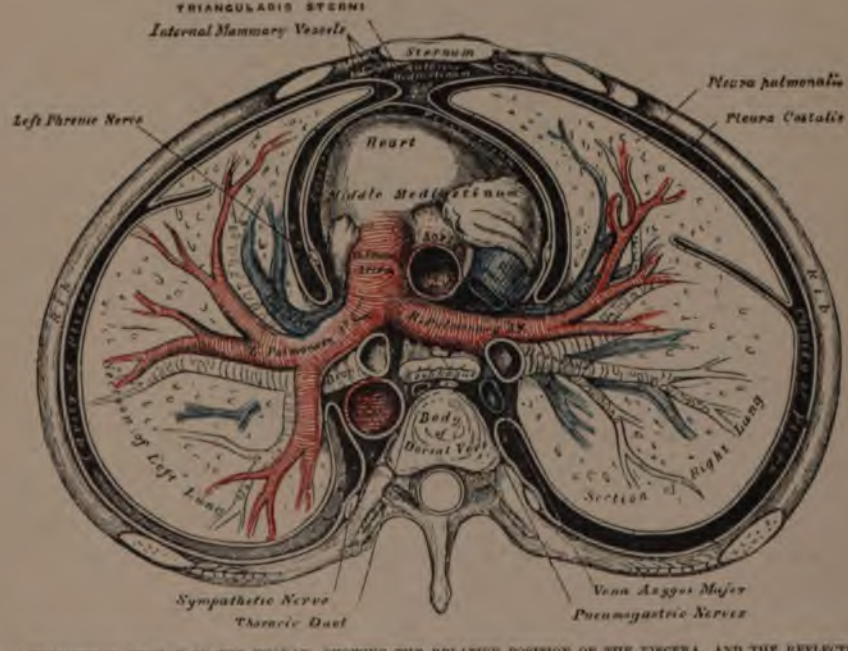


FIG. 462.—A TRANSVERSE SECTION OF THE THORAX, SHOWING THE RELATIVE POSITION OF THE VISCERA, AND THE REFLECTIONS OF THE PLEURÆ. (Gray.)

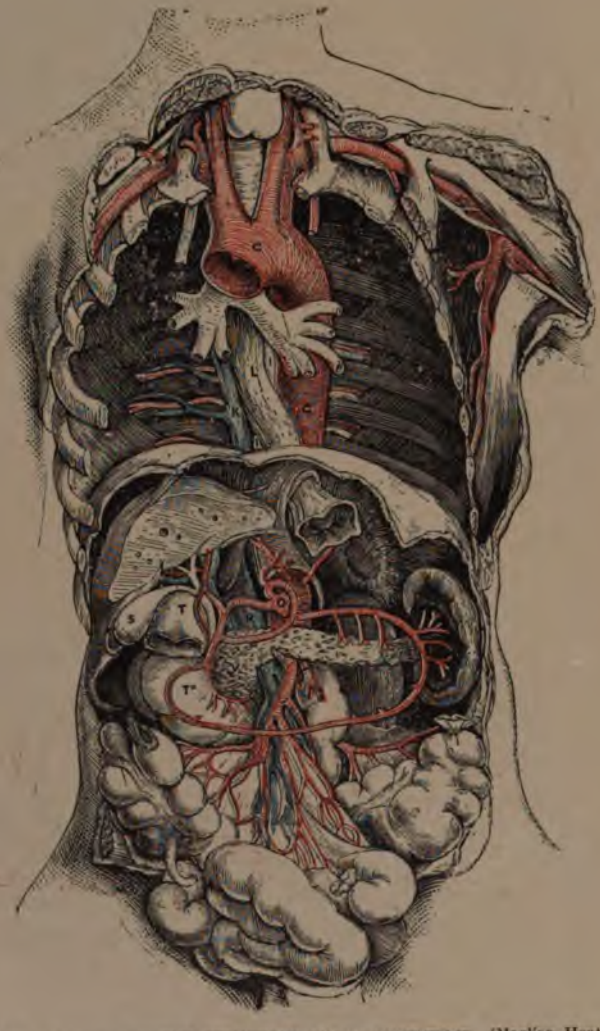


FIG. 463.—THE POSTERIOR MEDIASTINUM AND ITS CONNECTIONS. (Maclise, Heath.)

C, C, aorta; L, œsophagus; K, vena azygos major; I, I, thoracic duct. (See further expl., p. 228n.)

THE LUNGS.

Light, porous, crepitant, elastic.

Of a pinkish white at birth, of a mottled slate colour in the adult; the mottling becoming darker & darker as age advances. Smooth & shining, marked out by dark lines into polygonal spaces corresponding to the bases of the superficial lobules, which spaces are variously crossed by other more delicate lines.

Conical in shape, and presents: –

Outer Surface – Convex, deepest behind. Presents on either side a deep fissure oblique downwards & forwards from near apex to base, and, on the right side, another fissure oblique upwards & forwards from the middle of the foregoing. By these fissures the left lung is divided into two lobes, the right one into three; the inferior lobe is the largest in both lungs, and the middle lobe of the left side, the smallest of all.

Inner Surface – Concave, deeply excavated in front, especially on the left side, to make room for the heart; presents the hilum a little above & behind its middle.

Anterior Border – Thin, oblique, shorter than the posterior, deeply notched inferiorly on the left side so as to expose the pericardium; comes in contact with its fellow behind middle of sternum, the pleuræ alone being interposed.

Posterior Bordor – Thick, rounded, vertical, longer than the anterior.

Base – Broad, concave, oblique downwards & backwards; rests upon diaphragm, and its circumference fits into the groove between the diaphragm & the ribs. Descends lower down on the left side than on the right.

Apex – Passes up into root of neck an inch or an inch & a half above first rib, and, under cover of the scaleni, comes into close contact with first & second portions of subclavian artery.

THE RIGHT LUNG is the *shortest* in consequence of the diaphragm ascending higher on the right side than on the left; the *broadest* owing to the inclination of the heart to the left; and somewhat the *largest*. – THE LEFT LUNG is the *longest*, *narrowest*, and somewhat the *smallest*.

THE ROOT of the LUNG

Consists of the bronchus, pulmonary & bronchial vessels, lymphatic vessels & glands, and pulmonary plexuses of the pneumogastric & sympathetic, which parts are all enclosed in a pleural sheath, and are bound together by areolar tissue in the following order:

FROM BEFORE BACKWARDS

On Either Side: –

Pulmonary veins with the *anterior pulmonary plexus*;

Pulmonary artery;

Bronchus with the *bronchial vessels, lymphatics vessels & glands, and the posterior pulmonary plexus.*

FROM BELOW UPWARDS

On Right Side – *Pulmonary veins, pulmonary artery, bronchus,* with &c.

On Left Side – *Pulmonary veins, bronchus, pulmonary artery.*

THE ROOT OF THE RIGHT LUNG — Lies behind the superior vena cava & the right auricle; the vena azygos major arches over it from behind.

THE ROOT OF THE LEFT LUNG — Passes beneath the arch of the aorta; behind it are the descending portion of the arch, the œsophagus & the thoracic duct. – The root of each lung has also in front of it the phrenic nerve, and behind it, the pneumogastric.

THE PLEURA.

Surrounds the lung, lines the parietes of the thorax, and forms the lateral boundary of the mediastina.

Tracing it horizontally from the sternum it passes: –

Over costal cartilages, ribs, & intercostal spaces;
Forwards along side of posterior mediastinum;
Outwards over posterior aspect of root of lung;
Round posterior part of inner surface, posterior border, outer surface, anterior border, anterior part of the inner surface of lung, dipping into the fissures between the lobes
Inwards over anterior aspect of root of lung;
Forwards along side of pericardium to sternum.

Inferiorly it covers the diaphragm, from which a thin triangular fold, the *ligamentum latum pulmonis*, passes up along the side of the pericardium to the inner surface of the lung & to the lower border of its root.

Superiorly it ascends into the neck an inch or an inch & a half above the first rib, and, under cover of the scaleni, comes in contact with the first & second portions of the subclavian artery.

It is thinnest & most adherent over the lung & over the diaphragm. It is thickest & least adherent over the thoracic walls. Its inner surface is covered by a layer of pavement epithelium, and is moistened by a serous fluid.

Its arteries are from the intercostals, internal mammary, phrenic, inferior thyroid, pericardiac, & bronchial. – Its veins correspond to its arteries. – The lymphatics of the visceral layer join with those of the lung; the lymphatics of the parietal layer join with those of the mediastina & the thoracic walls. – Its nerves are derived from the pulmonary plexuses (Kölliker), and from the phrenic & sympathetic nerves (Luschka).

The two pleurae come in contact behind the middle of the sternum.

THE MEDIASTINUM.

(*Dissectional description; see new description, page 256a.*)

Is the antero-posterior septum comprised between the two lungs & pleurae. It is divided into three parts by the pericardium, heart, & large vessels.

Anterior Mediastinum – Is the part in front of the pericardium, heart, & large vessels. It is narrow above, where it contains the remains of the thymus gland, the origins of the sterno-hyoid & -thyroid, the upper part of the left internal mammary vessels, a large quantity of loose areolar tissue, & a few lymphatic glands. It is narrower still behind the middle piece of the sternum, where the two pleurae come in direct contact as low down as the 4th costal cartilage. Quite inferiorly, in consequence of the notch in the lower part of the anterior border of the left lung, it expands to the left behind the 4th & 5th intercostal spaces of the left side; here it contains the lower part of the left internal mammary vessels, & that part of the triangularis sterni muscle, which overlies the apex of the heart.

Middle Mediastinum – Is the part which contains the pericardium, heart & large vessels (ascending aorta, pulmonary vessels, superior vena cava; – the inferior vena cava enters pericardium through opening in cordiform tendon of diaphragm), and also the phrenic nerves. It is the widest part of the mediastinum.

Posterior Mediastinum – Is the part behind the pericardium, heart, & large vessels. It contains the descending aorta, trachea, œsophagus; the vena azygos major & minor & the left superior intercostal; the pneumogastric & splanchnic nerves; the thoracic duct; fat & lymphatic glands.

THE TRACHEA & BRONCHI.

THE TRACHEA.

From 6th cervical vertebra to 4th dorsal. Firm, rounded, & supported by cartilaginous rings in front, flattened & membranous behind.

Relations.

In Front –

Isthmus of thyroid gland, inferior thyroid veins, & thyroidea ima artery (when the latter exists).

Remains of thymus gland, left innominate vein, arch of aorta with innominate & left common carotid arteries, great or deep cardiac plexus, bifurcation of pulmonary artery.

Sterno-hyoid & -thyroid, anastomotic branches between the anterior jugular veins, sternum, fascia, & skin.

Behind –

Œsophagus, which deviates to the left towards lower part of neck; right recurrent laryngeal nerve.

On Either Side –

Lateral lobe of thyroid gland; common carotid artery, internal jugular vein, pneumogastric & sympathetic nerves; inferior thyroid artery, left recurrent laryngeal nerve (the right nerve lies somewhat behind the trachea).

Innominate & common carotid arteries, pneumogastric & left recurrent laryngeal nerves; – and farther off, but internally to the pleuræ, right innominate vein & right phrenic nerve, on the right side, left subclavian artery & left phrenic nerve, on the left.

THE BRONCHI

Commence opposite the 4th dorsal vertebra a little to the left of the middle line; the internal septum which marks the separation of the two tubes being slightly diviated to the left by the preponderance in diameter of the right bronchus over the left one. Both divide in the root of the lung into a large inferior and a somewhat smaller superior branch, the former of which, on the right side, gives off a small branch to the middle lobe of the right lung.

RIGHT BRONCHUS – About an inch in length, wider, more horizontal than the left one; enters root of lung opposite 5th dorsal vertebra. – It lies behind the superior vena cava & the right auricle; the right pulmonary artery lies at first below it, and then in front of it; the vena azygos major arches over it from behind.

LEFT BRONCHUS — Smaller, more oblique, nearly two inches long; enters root of lung opposite 6th dorsal vertebra. – It passes beneath the arch of the aorta; the left pulmonary artery lies at first above it, and then in front of it; behind it are the descending portion of the arch, the œsophagus & the thoracic duct.

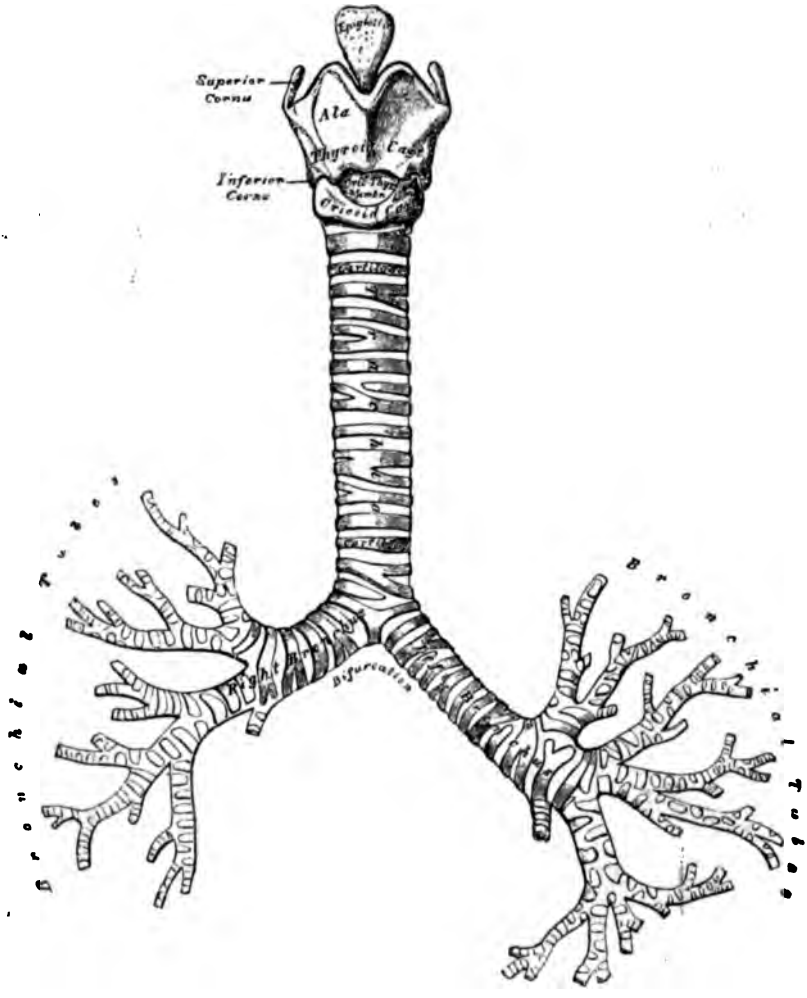


FIG. 464.—FRONT VIEW OF CARTILAGES OF LARYNX, TRACHEA, AND BRONCHI. (Gray.)

FIG. 465.—TRANSVERSE SECTION OF THE TRACHEA, JUST ABOVE ITS BIFURCATION, WITH BIRD'S-EYE VIEW OF THE INTERIOR. (Gray.)

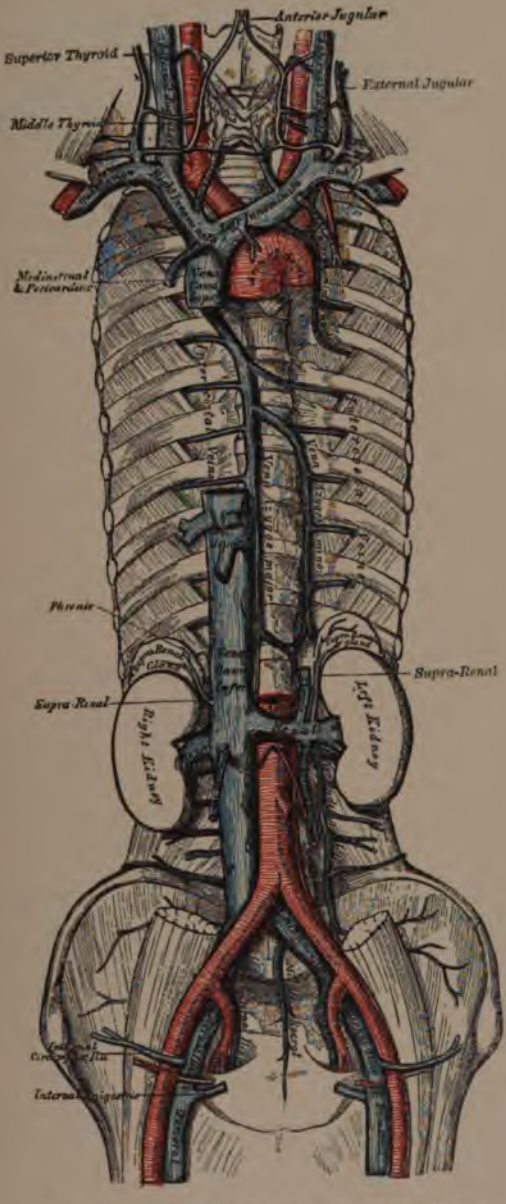


Fig. 466.—THE VENÆ CAVÆ AND AZYGOS VEINS. (Gray.)

Fig. 467.—THE THORACIC AND RIGHT LYMPHATIC DUCTS. (Gray.)

THE ŒSOPHAGUS.

Commences in middle line of neck opposite 5th cervical vertebra & lower border of cricoid cartilage.

Downwards & to the left behind trachea, left lobe of thyroid gland & left recurrent laryngeal nerve, coming into close contact with left common carotid.

Downwards & to the right behind lower end of trachea & commencement of left bronchus, and between arch of aorta & thoracic duct on the left & the vena azygos major on the right, regaining middle line opposite 5th dorsal vertebra.

Again to the left between heart & pericardium in front and lower part of thoracic aorta behind, being surrounded by the pneumogastrics, which tend, the left one to the front, the right one to the back.

Through œsophageal opening of diaphragm, and opens into stomach (cardiac or œsophageal opening) opposite 9th dorsal vertebra.

Is from 9 to 10 inches long.

THE VENÆ AZYGOS.

Collect the blood from the intercostal spaces, and are three in number, the major, minor left superior

VENA AZYGOS MAJOR, or RIGHT AZYGOS — Commences in the right ascending lumbar vein, or sometimes in a branch from the inferior cava or right renal. Through aortic opening of diaphragm on right side of thoracic duct, behind & right side of aorta; – sometimes through right crus. Along right side of spine in front of right intercostal arteries to 3rd dorsal vertebra. Arches forwards over root of right lung, and opens into superior vena cava just before it enters pericardium. Receiv

Tributary Branches: – *Nine or ten lower intercostal veins of right side, vena azygos minor, several small œsophageal, mediastinal & spinal veins, the right bronchial* sometimes the *right superior intercostal*, and occasionally the *left*

VENA AZYGOS MINOR, or LEFT LOWER AZYGOS — Arises in left ascending lumbar vein, or sometimes in a branch from left renal. Perforates left crus of diaphragm (passes sometimes through aortic opening), ascends along left side of spine in front of left intercostal arteries to 6th or 7th dorsal verteb. Crosses spine behind aorta & thoracic duct, and opens into vena azygos maj. Receiv

Tributary Branches: – *Four or five lower intercostal veins of left side, several sm mediastinal, œsophageal & spinal ve*

LEFT UPPER AZYGOS — Receives the blood from those left intercostal veins, usua two or three in number, which are situated between the intercostal veins th open into the left lower azygos and those that open into the left superior int costal. It therefore varies greatly in size, diminishing as these latter veins crease, & *vice versa;* often it does not exist at all, or one or more of the 5th, 6 & 7th left intercostal veins may merely open directly into the vena azygos maj When there is a distinct left upper azygos, it opens either into the azygos maj or into the left lower azygos. A few imperfect valves are found in the m azygos vein; distinct valves are found in the intercostal vei

THE THORACIC & RIGHT LYMPHATIC DUCTS.

THORACIC DUCT — Commences in receptaculum chyli, passes through aortic opening diaphragm, and then ascends in front of spine as high as 4th dorsal vertebra, lyi behind œsophagus, between aorta & vena azygos major. It then inclines to the le and ascends first behind arch of aorta and then behind first portion of subclavi artery of left side; and finally, opposite upper border of 7th cervical vertebra, it arcb forwards above pleura & in front of scalenus anticus, and opens into angle of junctio between left internal jugular & subclavian veins, its opening being guarded by a pa of valves. It is somewhat tortuous in its course, constricted at intervals on accou of the valves it contains; of the size of a goose-quill at its commencement, somewh narrower in the thorax, again enlarged at the root of the neck. Sometim it bifurcates, its left division taking the usual course, its right division joini the right lymphatic duct. – It is the common trunk of all the lymphatics of the bo except those of the right side of the head, neck, & thorax, right upper limb, rig lung, right side of the heart, & part of the convex surface of the liv

Receptaculum Chyli – Is a dilatation of the commencement of the thoracic du which lies in front of the 2nd lumbar vertebra, behind & to right side of t aorta, and between it and the vena azygos major & the right crus of t diaphragm. It receives the trunks of the lacteal vessels, and four or f large trunks from the lumbar lymphatic glan

RIGHT LYMPHATIC DUCT — Is a short thick trunk from half an inch to an inch length and of about a line or a line & a half in diameter, which collects the lym from the right side of the head, neck, & thorax, right upper limb, right lung, rig side of the heart, & part of the convex surface of the liver. It opens into the an of junction between the right internal jugular & right subclavian veins, its openi being guarded by a pair of valv

SUPERIOR INTERCOSTAL ARTERY.

From upper & back part of 1st portion of subclavian on left sid of 2nd portion on right side. Passes backwards for a short distance, a gives off its deep cervical branch; it then descends in front of neck of 1 rib, or in front of necks of 1st & 2nd ribs on outer side of 1st dorsal gan lion of sympathetic, gives off one or two branches similar to the aort intercostals, and joins with the first of the latter arteri

DEEP CERVICAL OR PROFUNDA CERVICIS – Sometimes arises directly from subclavia Backwards between neck of 1st rib & transverse process of 7th cervic vertebra, and ascends between complexus & semispinalis colli, anast mosing with vertebral artery & deep branch of arteria princeps cervici

INTERIOR of the HEART.

RIGHT SIDE.

Is larger in its auricular portion, and has thinner walls than the left.

AURICLE — Divided into:

Appendix Auriculæ – Narrow indented pouch, which overlaps the arch of the aorta, and presents on its inner surface the *musculi pectinati*, which extend somewhat into the sinus.

Sinus – The central cavity; presents: –

OPENING OF THE SUPERIOR VENA CAVA – Somewhat smaller than that of the inferior cava; situated at the upper & front part; looks downwards & forwards, and has near it the

Tubercle of Lower – Small eminence, scarcely visible in man, situated on right wall of auricle between the two venæ cavæ.

OPENING OF THE INFERIOR VENA CAVA – Somewhat larger than that of the superior cava; situated at the lower & back part near the septum; looks upwards & inwards, and presents the

Eustachian Valve – Semilunar in form with concave free, and convex attached margins; situated below the opening of the inferior vena cava between it & the auriculo-ventricular opening, and passes upwards & to the left to the anterior margin of the annulus ovalis. Small in the adult. Contains a few muscular fibres.

OPENING OF THE CORONARY SINUS – Situated below the opening of the inferior vena cava & the Eustachian valve. Presents the

Coronary Valve or Valve of Thebesius.

FORAMINA THEBESII – Some of which are the openings of the venæ cordis minimæ, while others are but small blind depressions.

AURICULO-VENTRICULAR OPENING – With the tricuspid valve (Vide below).

FORAMEN OVALE – In the fœtus. Situated at the lower & back part of septum above opening of inferior vena cava; replaced in adult by the

Fossa Ovalis – Oval depression surrounded by a prominent circular rim, the

Annulus Ovalis, – and which often presents a small valvular opening at its upper part.

VENTRICLE — Triangular in shape, and has much thinner walls than the left one. Prolonged upwards & to the left into the *Infundibulum or Conus arteriosus*. Presents: –

AURICULO-VENTRICULAR OPENING – Oval, broadest from side to side. Situated behind the centre of the sternum on a level with the 4th intercostal space, on the right side of the aortic & left auriculo-ventricular openings. Guarded by the

Tricuspid Valve – Presents three triangular segments, which are attached superiorly to the margin of the auriculo-ventricular ring & laterally to each other, and of which the left one is the largest. They are formed by a central fibrous lamina attached superiorly to the fibrous ring of the opening and covered by a duplicature of the endocardium. Their under surface & borders give attachment to the *chordæ tendineæ.*

OPENING OF THE PULMONARY ARTERY – Situated at the apex of the conus arteriosus opposite the upper border of the third costal cartilage of the left side close to the sternum. Guarded by the

Semilunar Valves – Three; formed of fibrous tissue surrounded by a duplicature of the endocardium, and present:

Convex margin – Attached to the fibrous ring of the orifice;

Free margin – Slightly concave, strengthened by a bundle of tendinous fibres, presenting in the centre a fibro-cartilaginous nodule, the *corpus Arantii*, and laterally two thin lunated portions, the *lunulæ*. Above the valves are three small pouches, the

Sinuses of Valsalva.

COLUMNÆ CARNEÆ – Three sorts, which are attached respectively by one side, by both extremities, by one extremity only, to the wall of the ventricle. The latter are the

Musculi Papillares – Three or four; give origin to the *Chordæ Tendineæ.*

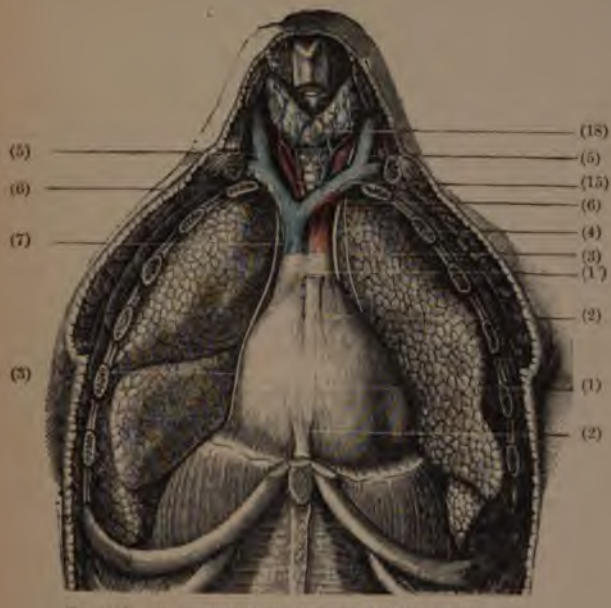


FIG. 468.—THE PERICARDIUM AND SURROUNDING PARTS. (Sappey.)

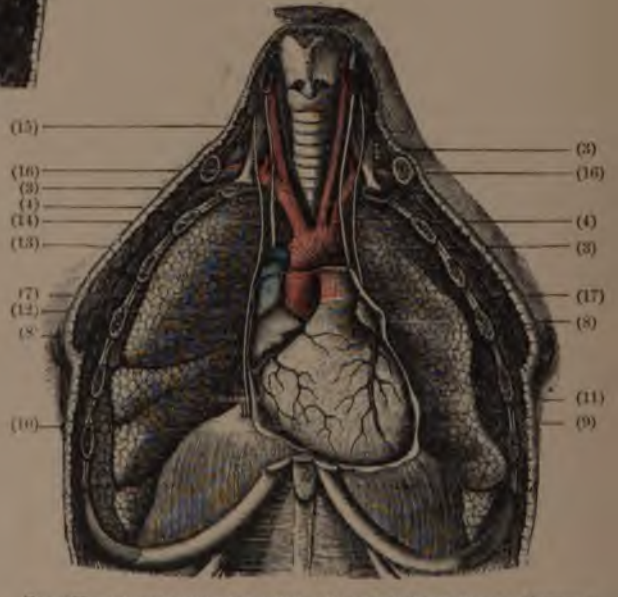


FIG. 469.—THE PERICARDIUM OPENED, AND SURROUNDING PARTS. (Sappey.)

In both Figures: 1, pericardium; 1', its prolongation upon the great vessels; 2, 2, sterno-pericardial ligaments; 3, 3, phrenic nerves; 4, 4, pneumogastric nerves; 5, 5, 6, 6, 7, internal jugular and innominate veins and superior vena cava; 8, 8, auricular appendices and right or posterior coronary artery; 9, 10, right and left ventricles; 11, left or anterior coronary artery; 12, 13, ascending and horizontal portions of the arch of the aorta; 14, 15, 15', 16, innominate, common carotid, and subclavian arteries; 17, trunk of pulmonary artery; 18, thyroid gland and inferior thyroid veins.

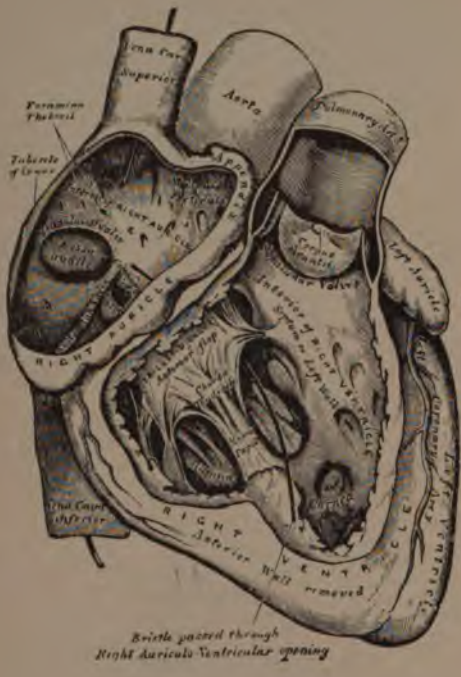


FIG. 470.—THE RIGHT AURICLE AND VENTRICLE LAID OPEN, THE ANTERIOR WALLS OF BOTH BEING REMOVED. (Gray.)

FIG. 471.—THE LEFT AURICLE AND VENTRICLE LAID OPEN, THE ANTERIOR WALLS OF BOTH BEING REMOVED. (Gray.)

INTERIOR of the HEART.

LEFT SIDE.

Has thicker walls than the right, and is smaller in its auricular portion.

AURICLE — Divided, as is the right, into two parts, the

Apendix Auriculæ – Longer, narrower, more curved & indented than on right s
and constricted at its orifice; its musculi pectinati are smaller &
numerous. Overlaps pulmonary art

Sinus – More regularly cuboid than on right side. – Presents:

Openings of the Pulmonary veins – Four, at upper part, two on the right s
to septum, two on the left, the latter sometimes uni

Auriculo-Ventricular Opening – Somewhat smaller, guarded by mitral v

VENTRICLE — Rounded & conical; its walls are thicker than those of the right. Prese

Auriculo-Ventricular Opening – Situated a little to the left of centr
sternum on a level with fourth costal cartilages, behind the a
opening. Somewhat smaller than on right side. Presents

Mitral Valve – Larger, thicker & stronger than the tricuspid. Consis
two principal segments, of which the largest is in front. The ch
tendineæ attached to its under surface are stronger & thicker, but
less numerous, than those on the right

Aortic Opening – Situated behind left border of sternum close to articula
with 3rd costal cartilage, and in front of the left auriculo-ventric
opening. Presents

Semilunar Valves – Larger, thicker & stronger than those of pulmo
artery; lunulæ wider, corpora Arantii more prominent, and sinus
Valsalva dee

Columnæ Carneæ – Those attached by one side and those attached by both e
mities are smaller & more numerous. The musculi papillares are
two in number, but are larger, and are attached, one to the ante
the other to the posterior wall of the ventr

STRUCTURE of the HEART—1st Tablet.

Presents for examination the fibrous rings of the arterial & auriculo-ventricular openings, and the muscular fibres.

FIBROUS RINGS — The aortic & the two auriculo-ventricular rings lie close together, – roughly speaking, behind the left half of the sternum, on a level with the 4th costal cartilages (see more precise statements in the several Tablets), and are bound together by a fibro-cartilaginous mass which becomes ossified in some of the larger animals. – The aortic ring lies in front of the left auriculo-ventricular; the right auriculo-ventricular ring lies between, & to the right of, the two others. – The fibrous ring of the pulmonary artery is situated at the apex of the infundibulum opposite the upper border of the 3rd costal cartilage of the left side close to the sternum.

These rings give attachment to the mitral tricuspid & semilunar valves, to the muscular fibres of the auricles, and to some of the most superficial fibres of the ventricles. The margin of the arterial rings which is turned towards the auricles, is scalloped into three semilunar notches filled up by corresponding projections of the middle coat of the artery, the attachment of the arteries to the rings being strengthened externally by the pericardium and internally by the endocardium.

MUSCULAR FIBRES — Are striated, but are about ⅓ smaller than those of striated muscles generally, and their striation is not so distinct. They divide and anastomose with each other, and they often contain fat cells. Their perimysium is but scanty.

Fibres of the Auricles – Are mostly transverse, superficial, & common to both auricles; some however lie deeper, and are proper to each auricle.

SUPERFICIAL, TRANSVERSE, OR COMMON FIBRES – Surround mainly the base of the sinuses, and are most marked anteriorly. Some dip into the inter-auricular septum.

DEEP OR PROPER FIBRES – May be divided into:

Looped Fibres – Arch over each auricle from before backwards, and are attached to the auriculo-ventricular rings both in front & behind.

Annular Fibres – Encircle the appendices auriculæ, and the venæ cavæ, pulmonary & coronary veins, extending for some distance upon the veins.

Fibres of the Ventricles – Vide next Tablet.

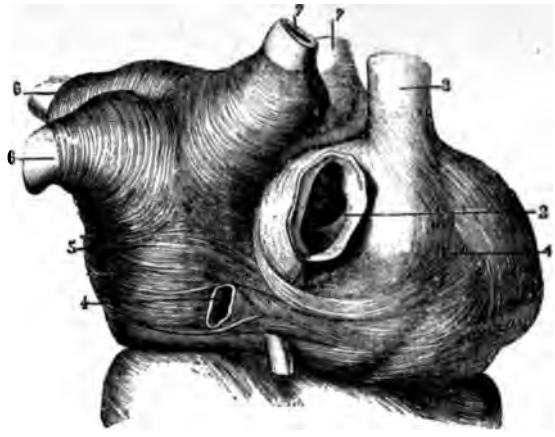


FIG. 172. - THE RIGHT AND LEFT AURICLES FROM BEHIND, WITH THE VESSELS OPENING INTO THEM, AND THEIR MUSCULAR FIBRES. (Sappey.)

1, the right auricle; 2, opening of the inferior vena cava and the Eustachian valve; 3, opening of the superior vena cava; 4, opening of the coronary sinus; 5, the left auricle; 6, 6, openings of left, and 7, 7, openings of right pulmonary veins.

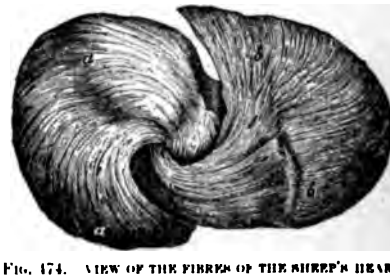


FIG. 174. VIEW OF THE FIBRES OF THE SHEEP'S HEART DISSECTED AT THE APEX TO SHOW THE VORTEX. (Pettigrew, Quain.)

a, *a*, fibres entering the apex posteriorly; *b*, *b*, fibres entering the apex anteriorly.

FIG. 173. - VIEW OF A PARTIAL DISSECTION OF THE FIBRES OF THE ANTERIOR WALL OF THE VENTRICLES IN A SHEEP'S HEART, DESIGNED TO SHOW THE DIFFERENT DEGREES OF OBLIQUITY OF THE SEVEN LAYERS OF FIBRES. (Allen Thomson, Quain.)

At the base and apex the superficial fibres are displayed; in the intervening space, more and more of the fibres have been removed from above downwards, the dissection reaching to a somewhat greater depth on the left than on the right. a', a', the superficial fibres of the right ventricle; b', b', the superficial fibres of the left ventricle; at 2 these superficial fibres have been removed so as to expose those of the second layer, which are seen to have the same direction as the superficial ones over the left ventricle, but a different direction over the right ventricle; at 3 some of these latter fibres have been removed to expose those of the third layer, which latter are seen to have a direction but slightly different; 4, fibres of the central or fourth layer, transverse or annular; 5, 6, 7, fibres of the fifth, sixth, and seventh layers, of opposite obliquity to those of the three outer layers, passing down to the apex to emerge at the whorl; between c, c, is the interventricular groove, over which the superficial fibres are seen crossing above and below; in the central parts of the groove, some of the deeper fibres are seen to turn backwards into the septum; d, the pulmonary artery; e, the aorta.

FIG. 475.—PORTION OF THE WALL OF THE VENTRICLE, *d*, *d'*, AND AORTA, *a*, *b*, *c*; SHOWING THE ATTACHMENTS OF THE AORTIC VALVES, AND OF ONE FLAP OF THE MITRAL VALVE. (Quain.)

a, *b*, *c*, sinuses of Valsalva (*a* and *b* with openings of coronary arteries); 1, 2, attached border of the semilunar valve; 3, corpus Arantii in the middle of the free border of the valve. The lunulæ are seen on either side of 3; *g* and *h*, muscular papillares; *e*, *e'*, *f*, attachment of the chordæ tendinæ.

FIG. 476.—VIEW OF THE BASE OF THE VENTRICULAR PART OF THE HEART, SHOWING THE RELATIVE POSITION OF THE ARTERIAL AND AURICULO-VENTRICULAR ORIFICES. (Allen Thomson, Quain.)

The pulmonary artery and aorta, and the auricles, have been removed; the muscular fibres are exposed by the removal of the pericardium, fat, blood-vessels, &c.; the valves are in a closed condition. 1, 1, right ventricle; 1', conus arteriosus; 2, 2, left ventricle; 3, 3, the divided wall of the right auricle; 4, that of the left; 5, 5', 5'', the three segments of the tricuspid valve; 6, 6', the two segments of the mitral valve (in the angles between these segments are seen smaller lobes); 7, the *pulmonary artery; 8 placed on the root of the aorta; 9, the right or posterior; 9', the left or anterior* coronary *tery.*

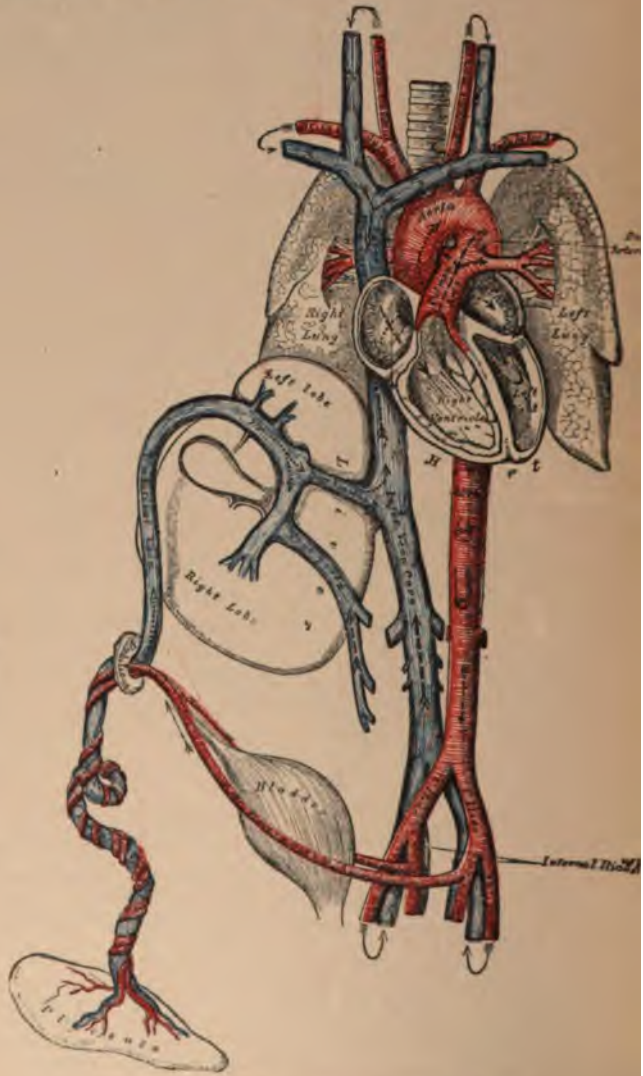


FIG. 477.—PLAN OF THE FŒTAL CIRCULATION. (Gray.)

CIRCULATION IN THE FULLY DEVELOPED FŒTUS.

The blood which has been oxygenated in the placenta returns to the fœtus by the

Umbilical Vein. This runs in the umbilical cord, through the umbilicus, and in the folds of the suspensory or falciform ligament to the under surface of the liver, – where it passes backwards in the fissure for the umbilical vein as far as the transverse fissure. Here the umbilical vein gives off lateral branches and bifurcates, and the blood stream divides into three courses.

1st Course.—Before the umbilical vein bifurcates, it gives off several branches to the quadrate, Spigelian, & left lobes; after distribution to the liver, this blood is collected by the hepatic veins and poured into the inferior vena cava.

2nd Course.—One branch of bifurcation of the umbilical vein passes with the portal vein to the right lobe proper, whence the blood is again collected by the hepatic veins and poured into the inferior vena cava.

3rd Course.—The other branch of the bifurcation passes on as the ductus venosus, which, acting as a bridge, pours the remaining blood direct into the inferior vena cava.

It may here be noted (1) that the umbilical vein & ductus venosus carry arterial blood, and (2) that, although in the advanced stages of fœtal life the ductus venosus carries most of the arterial blood directly into the inferior vena cava, in the early stages, on the contrary, most of the arterial blood passes through the liver. This accounts for the full development of that organ in the fœtus. The

Inferior Vena Cava above the liver thus carries the whole of the placental blood, – with the return blood from the other viscera and lower limbs, – to the

Right Auricle. Here two blood streams meet and slightly intermix, – *the ascending arterial stream* now being dealt with, and *the descending venous stream*, which latter must be parenthetically alluded to.

The *descending venous stream*, derived, as explained later on, from the head, neck, & upper limbs, and entering the right auricle by the superior vena cava, is, by the obliquity of that vessel, directed forwards in front of the ascending arterial stream. It is thus that it reaches the *right* ventricle.

The *ascending arterial stream*, entering the right auricle by the inferior vena cava, is turned backwards by the Eustachian valve, very large in the fœtus, and thus directed behind the former stream and through the foramen ovale to the

Left Auricle, whence it passes to the

Left Ventricle, and so to the

Aorta.

From the aorta, the ascending arterial stream passes almost entirely to the

Head, Neck, & Upper Limbs.

This is through a second meeting of opposite, or intersecting, currents, which occurs in

the arch of the aorta, again, practically, between the same ascending arterial and the descending venous streams.

The blood from the left ventricle (the ascending arterial stream) passes up mainly, as above stated, to the head, neck, & upper limbs, *because* the distal portion of the aorta is largely occupied by the descending venous stream from the right ventricle, which has reached the aorta *in advance of* the former through the pulmonary artery & the ductus arteriosus.*

The venous blood from the head, neck, & upper limbs returns by the large vessels to the

Superior Vena Cava, and so to the

Right Auricle, – (where it forms the descending venous stream above referred to, – and, slightly mixing with the ascending arterial stream, passes down in front of it to the

Right Ventricle, and then to the

Pulmonary Artery. Very little of this blood – mainly venous blood – passes to the lungs, which have not yet been inflated; what does, returns by the pulmonary veins to the left auricle. Most of the blood from the pulmonary artery passes through the

Ductus Arteriosus to the

Aorta, *beyond the large vessels to the head, neck, & upper limbs.* This blood – mainly venous blood – is then carried by the aorta and its branches:—

[1] **to the Viscera;**

[2] **to the Placenta,** – whence, after being reoxygenated, it starts once more on the course above described;

[3] **to the Lower Limbs;** – hence the undeveloped condition of these parts in fœtal life.

* The circumstance that nearly the whole of the arterial blood passes up to the head, neck, & upper limbs, accounts *the full development of these* parts in the fœtus.

STRUCTURE of the HEART—2nd Tablet.

FIBRES OF THE VENTRICLES

Form seven layers differing from each other by the direction of their fibres.

These layers are continuous with each other at the apex & at the base of the heart a follows: – the 1st, or most external layer, with the 7th, or most internal layer.
" 2nd, " 6th,
" 3rd, " 5th,
The fibres of the 4th or central layer return upon those of the same set.

Together, the 1st & 7th layers form a kind of double ring inclosing all the other layers the 2nd and 6th layers, a kind of double ring inclosing the 3rd, 4th, and 5th layers the 3rd and 5th layers, a kind of double ring inclosing the 4th layer. As a conse quence the double ring formed by the 1st and 7th layers extends farther towards th apex & the base of the heart than the double ring formed by the 2nd & 6th layers which latter double ring extends farther than the double ring formed by the 3rd & 5t layers; and the 4th or central layer is the least extensive of all. This explains th greater thickness of the walls of the ventricles towards the middle of their length tha at either extremity. – The outer layers, it may be added, are thinner than the inne ones.

The fibres of the three outer layers are inclined downwards & to the left on the anteric aspect of the heart, downwards & to the right on the posterior aspect; and they becom less vertical in each successive layer. The fibres of the 4th layer are horizontal c transverse. The fibres of the three inner layers are inclined upwards & to the lef on the anterior aspect of the heart, upwards & to the right on the posterior aspec crossing the fibres of the three outer layers, and becoming more & more vertical o longitudinal in the successive strata.

Some of the superficial fibres, especially those of the posterior surface, pass round and en close both ventricles; the mass of the fibres, however, enclose but one ventricle.

In the three outer layers the anterior fibres proper to the left ventricle issue from the inne & front part of the corresponding arterial & auriculo-ventricular openings & from th front of the interventricular septum; these anterior fibres pass downwards & to th left, with a few of the anterior common superficial fibres, and get to the back part o the apex. The posterior fibres proper to the left ventricle issue from the outer & bac part of the corresponding arterial & auriculo-ventricular openings & from the back o the interventricular septum; these posterior fibres pass downwards & to the right, wit a somewhat considerable number of the posterior common superficial fibres, and get t the front of the apex. Here all the fibres, both anterior & posterior, curl inwards i a whirl-like manner, the anterior fibres going to form the three inner strata on th posterior wall of the ventricle, and the posterior fibres going to form the three inne strata on the anterior wall.

In the right ventricle the fibres of the three outer layers issue partly from the correspond ing arterial & auriculo-ventricular openings, and are partly continuous with th posterior common superficial fibres. Descending spirally from left to right on th posterior aspect of the heart, and from right to left on the anterior aspect, they reac the anterior interventricular groove. Here a few fibres are continued on to the lef ventricle, forming the anterior common superficial fibres; the greater number pas backwards, however, in the interventricular septum, at the back of which they decus sate with the fibres of the left ventricle, and blend with the posterior common super superficial fibres.

It must be added that none of the fibres, except a few of the most superficial ones, can now be said to *arise* from the arterial & auriculo-ventricular rings. The strata are merely continued opposite these rings, the superficial ones into the deep ones, and *vice versa*

[ERVES of the HEART.

Are derived from the cardiac plexuses, which plexuses are formed by the cardiac branches of the sympathetic and of the pneumogastric & recurrent laryngeal.

CARDIAC NERVES — Are the three cardiac nerves of the sympathetic, the cervical-cardiac & the thoracic-cardiac nerves of the pneumogastric, and the cardiac branches of the recurrent laryngeal.

CARDIAC NERVES OF THE SYMPATHETIC — Are three in number, *superior or superficial, middle or great, & inferior*, and arise normally *from* the corresponding *cervical ganglia*. The superior cardiac nerve, however, frequently arises partly from the communicating cord below the superior ganglion, and the inferior one partly from the first dorsal ganglion; when the middle ganglion is absent the middle cardiac nerve arises from the communicating cord between the superior & inferior ganglia.

These nerves pass downwards & inwards *to the base of the heart* either singly or in connection with each other or with the other cardiac nerves, varying considerably in their relative size and in their precise relations to adjoining structures; when one of them is smaller than usual one of the others is increased in size.

On the *right side* of the neck the *superior & the middle* cardiac nerves pass downwards *behind the common carotid* artery, the former passing also in front of the inferior thyroid artery & recurrent laryngeal nerve. They then *cross the subclavian artery* either in front or behind, and descend *upon the trachea to* the right side of the *great or deep cardiac plexus*. – On the *left side* the *superior cardiac nerve* usually descends into the thorax *between & in front of* the *left common carotid & left subclavian* arteries and crosses anteriorly the *arch of the aorta to* the *superficial cardiac plexus;* sometimes however it lies deeper than usual and then passes behind the aorta to the deep cardiac plexus. – The *left middle cardiac nerve* passes into the thorax *between & behind the left common carotid & left subclavain arteries*, and then descends *behind the arch of the aorta to* the left side of the *deep cardiac plexus.*

The *inferior cardiac nerve* passes downwards & inwards *to the deep cardiac plexus behind the subclavian artery*, and also, on the right side, behind the *innominate.*

CARDIAC NS. of the PNEUMOGASTRIC & RECURR. LARYNGEAL

Are divided into:

Cervical Cardiac – Are divided into:

Upper Cervical Cardiac – Small branches which join the cardiac nerves of the sympathetic.

Lower Cervical Cardiac – One large branch which, on the right side, descends along the innominate artery and joins one of the cardiac nerves destined to the deep cardiac plexus, and, on the left side, crosses the arch of the aorta to the superficial cardiac plexus.

Thoracic Cardiac – Arise on the right side both from the trunk of the pneumogastric & from its recurrent laryngeal branch, but on the left side from the recurrent branch only. They all go to the deep cardiac plexus either singly or in connection with the other deep cardiac nerves.

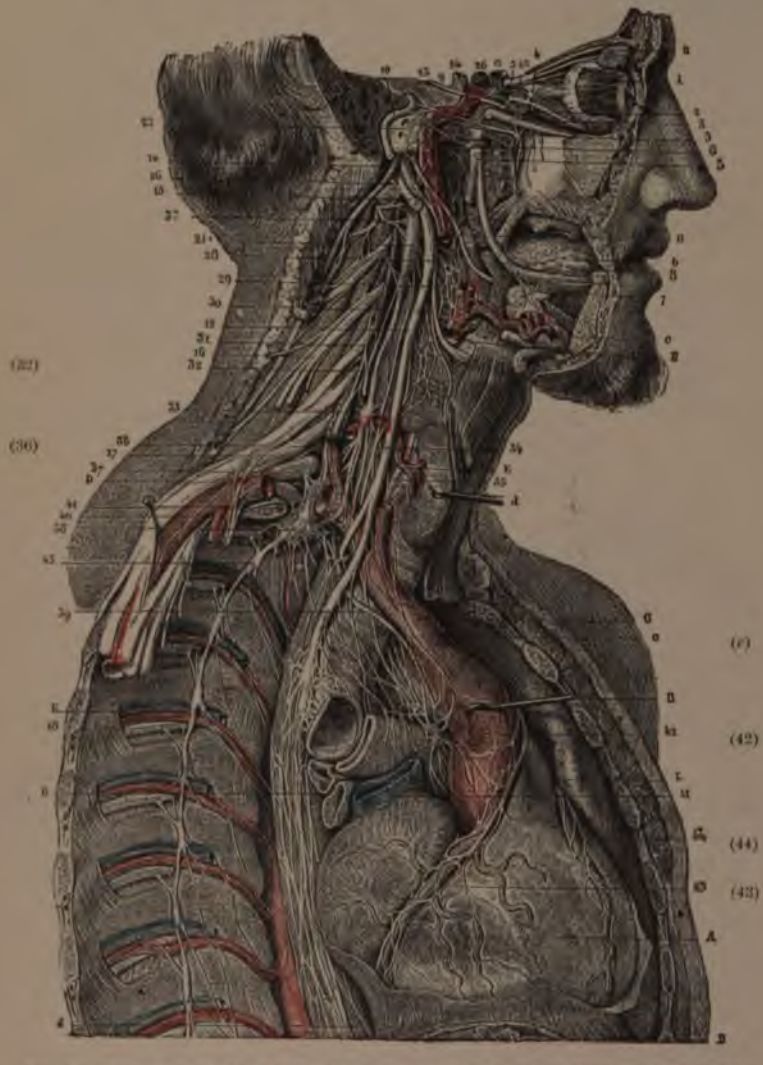


FIG. 478.—DISTRIBUTION OF THE RIGHT PNEUMOGASTRIC & SYMPATHETIC NERVES. (Hirschfeld.)

B, arch of aorta drawn forwards so as to show the trachea, *r*, the divided bronchus, the right pulmonary artery, the termination of the superior vena cava, M, and the right pulmonary veins, O; 42, great or deep cardiac plexus, lying, in its right half, in front of the trachea and above the right pulmonary artery, and extending, in its left half, on the left side of the trachea. (The cardiac nerves will easily be followed down from the pneumogastric and from the three cervical ganglia of the sympathetic, 21, 33, and 38, though only the middle one, 38, is numbered.) 43 & 44, posterior and anterior coronary plexuses.

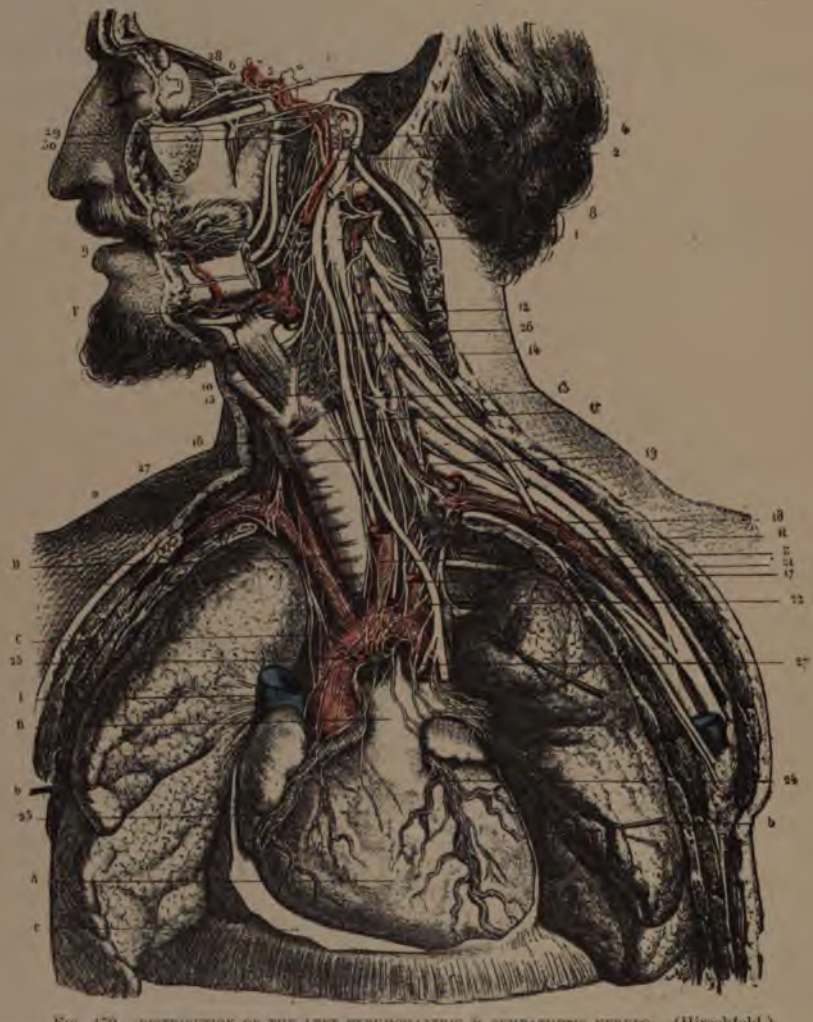


FIG. 479.—DISTRIBUTION OF THE LEFT PNEUMOGASTRIC & SYMPATHETIC NERVES. (Hirschfeld.)

R, trunk of the pulmonary artery, with its right and left branches, the left one being joined to the under surface at the arch of the aorta by the ductus arteriosus, on the left side of which is seen the origin of the left recurrent laryngeal nerve, 27; on the right side of the arch of the aorta is seen the termination of the superior vena cava, I.

23, superficial cardiac plexus, with the ganglion of Wrisberg. The three cardiac nerves of the sympathetic, 11, 17, and 22, will easily be traced down from the three cervical ganglia, 1, 13, and 18. 24 and 25, anterior and posterior coronary plexuses. (See expl., p. 256w.)

HE CARDIAC PLEXUS.

The cardiac nerves form two primary cardiac plexuses termed the superficial & the deep or great, and two secondary plexuses, the anterior & the posterior coronary, which two latter plexuses are derived from the preceding, as are also in part the anterior & the posterior pulmonary plexuses.

SUPERFICIAL CARDIAC PLEXUS — The smaller. Is situated beneath arch of aorta in front of right pulmonary artery and on right side of ductus arteriosus. It communicates by several filaments with the left half of the deep cardiac plexus.

It is formed by the left superior cardiac nerve of the sympathetic, the left inferior cervical cardiac branch of the pneumogastric, and by several filaments from the deep cardiac plexus. It often presents a small ganglion, the ganglion of Wrisberg.

It gives off the greater part of anterior coronary plexus, and several filaments to anterior pulmonary plexus of left side.

DEEP OR GREAT CARDIAC PLEXUS — The larger. Is situated between trachea & arch of aorta, its right half lying above right branch of pulmonary artery, its left half lying rather on left side of trachea and being connected by several filaments with the superficial plexus.

It is usually formed by every one of the cardiac nerves excepting the left superior cardiac nerve of sympathetic & left inferior cervical cardiac nerve of pneumogastric.

Its right half sends branches – behind right pulmonary artery to posterior coronary plexus & to right auricle; – in front of right pulmonary artery, outwards, to right anterior pulmonary plexus, inwards, in front of pulmonary trunk to anterior coronary plexus. – Its left half gives off: – several filaments to superficial cardiac plexus, numerous filaments to posterior coronary plexus & to left auricle, a few branches to left anterior pulmonary plexus.

ANTERIOR CORONARY PLEXUS — Is derived chiefly from the superficial cardiac plexus, but partly also from the deep. It passes forwards between aorta & pulmonary artery and accompanies the left or anterior coronary artery & its branches.

POSTERIOR CORONARY PLEXUS — Is derived chiefly from the left half of the deep cardiac plexus, but partly also from the right. Its branches accompany the right or posterior coronary artery and its branches.

The filaments of the coronary plexuses ramify in the substance of the heart and beneath the pericardium & endocardium. Numerous small ganglia are found upon them, especially in the vicinity of the boundary rings between the auricles & ventricles.

PLANCHNIC NERVES.

Usually three in number, and termed *great*, *lesser*, & *least*.

Arise as follows from the six or seven lower dorsal ganglia:

Great Splanchnic Nerve – Ganglia from 5th or 6th to 9th or 10th: – Is also connected with the dorsal ganglia above as high as the 3rd, or sometimes even as high as the 1st.

Lesser Splanchnic Nerve – 10th & 11th ganglia.

Least Splanchnic Nerve – 12th ganglion.

Pass downwards & inwards upon bodies of vertebræ being either more or less separate & distinct from each other, or more or less plexiform, and frequently presenting, when plexiform, either one relatively large ganglion, the ganglion splanchnicum, or several smaller ones.

Perforate diaphragm conjointly or separately.

End, the two first mainly in solar plexus, the last mainly in the renal. – The majority of the fibres of the great splanchnic nerve descend directly to the semilunar ganglion of same side.

The great splanchnic nerves are white & firm in texture, as are also the branches of the superior mesenteric plexus

GANGLIATED CORDS & GANGLIA of SYMPATHETIC

GANGLIATED CORDS — Lie on each side & along the whole length of spinal column, converging inferiorly upon the coccyx in the ganglion impar, and being prolonged superiorly into the head along internal carotid artery. They are usually single, sometimes double, occasionally wanting here & there. Relatively to the size of the ganglia they are largest in the dorsal region. They are divided into:

Cervical Portion – Lies in front of transverse processss of cervical vertebræ behind internal jugular vein, and presents three ganglia (Vide Cervical portion of Sympathetic).

Thoracic Portion – Lies in front of heads of ribs & intercostal vessels, beneath pleuræ, on outer side of venæ azygos, at first at a small distance from, and then close to, bodies of vertebræ. It presents eleven or twelve ganglia.

Lumbar Portion – Penetrates into abdomen, on right side through a small opening in right crus of diaphragm, on left side either through aortic opening or through a small separate opening in left crus. It lies in front of bodies of vertebræ on inner side of psoas, behind inferior vena cava on the right side, behind abdominal aorta on the left. It presents four or five ganglia.

Sacral Portion – Lies in front of sacrum on inner side of anterior sacral foramina, and, converging towards its fellow inferiorly, usually ends in the ganglion impar.

PREVERTEBRAL GANGLIA — Usually three cervical, eleven or twelve dorsal, four or five lumbar, four sacral, one coccygeal. More or less oval or triangular in shape, and elongated from above downwards.

Cervical – Vide cervical portion of sympathetic.

Dorsal – Lie most of them in front of heads of ribs, the nine or ten first at a little distance from, the two or three last close to, bodies of corresponding vertebræ; occasionally one or two ganglia lie opposite the corresponding intervertebral foramina. They are smaller than the cervical & lumbar. The first one is the largest and is often blended with the inferior cervical. The last one is usually stellate in shape, and is sometimes blended with the first lumbar. – They present:

ROOTS, OR BRANCHES OF COMMUNICATION WITH THE DORSAL NERVES – Usually two in number: – Either both ascend obliquely upwards & outwards to join the dorsal nerve above just before its bifurcation, or one ascends as above described, and the other descends to join the dorsal nerve below in corresponding situation. Sometimes one or two ganglia have a third root resulting from bifurcation of one of the roots to adjoining dorsal nerves, and even, occasionally, an additional root to second dorsal nerve above.

INTERNAL BRANCHES, OR BRANCHES OF DISTRIBUTION – Those from five or six upper ganglia are small & greyish; they mainly supply thoracic aorta & its branches, & bodies of vertebræ & their ligaments; those from third & fourth ganglia join posterior pulmonary plexus. Those from six or seven lower ganglia are larger & whiter; they give off a few small branches to aorta, and join to form the great, lesser, & last splanchnic nerves (V. Solar Plexus).

Lumbar – Rather larger & more distinct than the dorsal, and situated at a greater distance from the corresponding intervertebral foramina, the first one often lying opposite body of second lumbar vertebra, and the last one opposite sacro-vertebral articulation. – They present:

ROOTS, OR BRANCHES OF COMMUNICATION WITH THE LUMBAR NERVES – Two or three for each. Are longer & more slender than those of dorsal ganglia, and pass beneath the fibrous arches of psoas in company with lumbar arteries & veins.

INTERNAL BRANCHES, OR BRANCHES OF DISTRIBUTION – Give a few twigs to bodies of vertebræ & their ligaments, and assist in forming the aortic & hypogastric plexuses.

Sacral – Smaller than the dorsal & lumbar, and diminish in size as they descend; lie close to inner side of anterior sacral foramina, those of opposite sides approximating as they descend, and usually blend in front of coccyx in a median ganglion, the cocoygeal ganglion or ganglion impar. – They present

ROOTS, OR BRANCHES OF COMMUNICATION WITH THE SACRAL NERVES – Usually two for each ganglion; are short & small.

INTERNAL BRANCHES, OR BRANCHES OF DISTRIBUTION – Those of the two upper ganglia join inferior hypogastric or pelvic plexus; the others descend upon the arteria sacra media, and supply the sacrum & coccyx & their ligaments, and the coccygeal gland

DIVISIONS OF THE MEDIASTINUM.

The considerable bulging, below, of the middle mediastinum as hitherto described unbalanced as it is by any corresponding bulk above, has long induced a general and not unnatural desire to add a *horizontal* division to the previous double vertical division which led to the classical description of *three* mediastina, – the anterior, the middle, and the posterior. Some want of harmony, however, regarding such horizontal division has long resulted among anatomists from the difficulty of agreeing upon an artificial demarcation where no precise natural demarcation exists. A horizontal division by a plane passing from the junction of the manubrium and gladiolus sterni to the lower part of the fourth dorsal vertebra is proposed, and now somewhat generally accepted; though it has the evident inconvenience of cutting the arch of the aorta into three portions contained in different sections of the mediastinum,* and the superior vena cava and trachea each into two portions also contained in different sections, and, of course, of similarly dividing all the long organs, – as the œsophagus, thoracic duct, pneumogastric & phrenic nerves, – which traverse the thorax throughout.† This division recognises *four* sections of the mediastinum, or *four mediastina*, which, in so far as they differ from the older sections, – and it will be seen that the anterior, middle, and posterior mediastina, as below described, are considerably curtailed, – may be briefly described as follows:—

Superior Mediastinum.—Comprised between the manubrium sterni in front, the four upper dorsal vertebræ behind, the above-mentioned plane below (which practically corresponds to the upper limit of the pericardium), and the upper opening of the thorax above. It contains the *transverse portion* of the arch of the aorta, with the innominate artery and the thoracic portions of the left common carotid and left subclavian; the innominate veins and the *upper part* of the superior vena cava, and the left superior intercostal vein; the trachea down to a little above its bifurcation; the upper part of the several "long organs" above named, including the left recurrent laryngeal nerve; the origins of the sterno-hyoid & -thyroid muscles; the remains of the thymus gland.

Middle Mediastinum.—Contains, in addition to the heart and pericardium, the *ascending portion* of the arch of the aorta, the *lower part* of the superior vena cava, with the termination of the vena azygos major; the bifurcation of the trachea and the two bronchi; the pulmonary artery with its two branches, and the pulmonary veins; the lower part of the phrenic nerves.

Posterior Mediastinum.—Contains the *descending portion* of the arch of the aorta, and the thoracic aorta; the venæ azygos major & minor; the splanchnic nerves; and, of course, the lower part of the "long organs," the phrenic nerves excepted.

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* At first sight this would appear not to be so, since, according to still recognised descriptions, the level of the lower border of the fourth dorsal vertebra is that at which the arch of the aorta ends; but all the levels of the thorax are now lowered by one vertebra (see Bifurcation of trachea, &c., page 256o), so that the termination of the arch of the aorta, *not described embryologically*, should be placed opposite the lower border of the *fifth* dorsal vertebra. The remark in the text does not of course apply to the arch as described embryologically (see page 256j), since this is shortened at both ends.

† It must be borne in mind that the segmentation of at least the superior vena cava and the arch of the aorta at the junction of its first and second portions rests to a certain extent on a natural basis, – that of their pericardial investment. It is, roughly speaking, the portion of these vessels invested by the pericardium that is contained in the middle mediastinum, and the portion that is not so invested that is contained in the superior mediastinum.

two auricular appendices. A septum grows backwards from the common anterior wall, but is not completed till after birth, a communication (foramen ovale) being left between the two auricles during the whole of fœtal life.

(3.) A septum extending backwards from the distal end of the aortic bulb now divides the bulb into an anterior portion, or *pulmonary artery*, which remains in connection with the right ventricle, and a posterior portion, or *aorta proper*, which remains similarly connected with the left ventricle.

II.

Aortic Arches.

Much confusion has resulted, in the description of the aortic arches, from the lax use of terms. It will be endeavoured here to introduce some precision. It will further be attempted to make this difficult subject as comprehensible as it is susceptible of being made by stating the facts of the case, first in reference to the fœtal structures, then in reference to the normal adult structures, and finally in reference to the abnormal adult structures most frequently met with. A portion of Section IV. is quoted from the admirable article on the subject in the last edition of Quain's "Anatomy."

For the sake of clearness, the two primitive aortæ will be taken to consist of an ascending portion, or *ascending root*, of a descending portion, or *descending root*, and of an

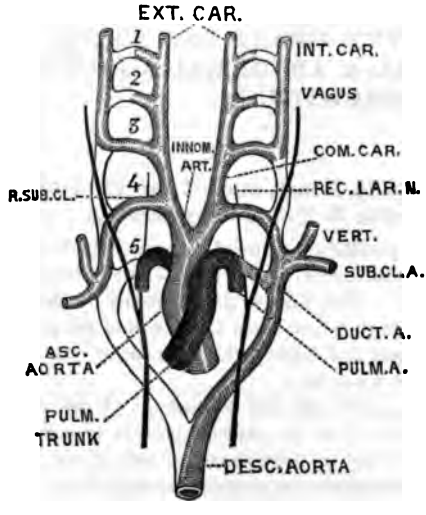

FIG. 20.—DIAGRAM SHOWING THE MODE OF DEVELOPMENT OF THE LARGE ARTERIES. (QUAIN.)

upper arched portion, or *first aortic arch*. Of the four arches, – termed second, third, fourth, and fifth aortic arches, – which appear in succession behind the first aortic arch, the three

latter, the third, the fourth, and the fifth, are alone of practical significance to the anatomist. It is the evolution of these three arches only that is at all clearly made out. Very conflicting views still prevail with reference to the evolution of the two other, or two first arches, though definite statements, as will be seen below, are now put forward as to their transformations.

With reference to its subsequent evolution, the *ascending root* may be divided into two portions, – an *upper portion* (above the fourth arch), and a *lower portion* (below the fourth arch), – the latter evolving differently on the two sides of the neck, and the former, on the contrary, evolving similarly on both sides.

Upper portion of the Ascending Root.—The lower part of this, – that between the third and fourth arches, – becomes the *common carotid* artery; the upper part, – that above the third arch, – becomes the *external carotid.*

The Lower portion of the Ascending Root, – that below the fourth arch, – forms, on the right side, the *innominate artery*, and, on the left side, where it soon becomes much larger, the *portion of the arch of the aorta that is comprised between the innominate and left common carotid arteries.**

The *left fourth arch* forms the portion of the arch of the aorta beyond the origin of the left common carotid.

The *right fourth arch* forms a portion of the subclavian artery [as far as the origin of the vertebral (Quain), or of the superior intercostal (Macalister)].

The *left fifth arch* forms the distal part of the pulmonary artery† and the ductus arteriosus, – two lateral branches being given off to the lungs.

The *right fifth arch* disappears.

The *third arch* forms on both sides the first part of the internal carotid artery.

The *Descending Root* atrophies, on the *left side*, between the third and fourth arches, and, on the *right side*, both between the third and fourth arches, and below the fourth arch. The *upper part of the descending root*, – that is, the part between the second and third, and between the first and second arches, – becomes the upper part of the internal carotid artery.

The *posterior part of the two first arches* atrophies. There are probably developed from the *anterior part* of the *first arch* the internal maxillary and temporal arteries, and from the anterior part of the *second arch* the lingual and ascending pharyngeal arteries, and also, perhaps, the occipital and the posterior auricular arteries.

III.

Normal Adult Structures.

The above statements in reference to the embryonic state may now be put conversely, and made referable to the adult condition.

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* It will be seen, and the point will be made plainer further on, that the *portion of the arch of the aorta comprised between the innominate artery and the left common carotid* is the *homologue*, on the left side of the body, of the *innominate artery on the right side.*

The portion of the arch of the aorta comprised between the commencement of the aorta and the origin of the innominate artery, – that is to say, the portion of the completely developed normal artery contained in the pericardium, – resulting, as has already been stated, from the partitioning of the aortic bulb, will be seen to be the *common trunk*, which *bifurcates* into the *two originally equally important homologous arteries* above referred to.

† The portion not contained in the pericardium.

The *distal* part of the *pulmonary artery* and the ductus arteriosus are the modified left fifth arch, – the branches to the right and left lungs being two lateral branches subsequently given off from the above trunk. .The *proximal* portion of the pulmonary artery contained within the pericardium is the anterior half of the partitioned arterial bulb.

The portion of the *arch of the aorta* contained within the pericardium is the posterior half of the partitioned arterial bulb. The portion comprised *between the innominate and left common carotid arteries* is the modified lower part of the left ascending root. The portion comprised *between the common carotid artery and the origin of the left subclavian artery* is the modified left fourth arch. The portion *beyond the left subclavian artery* is the modified lower part of the left descending root. Embryologically, the arch of the aorta consists, therefore, of four different parts.

The *innominate artery* is the modified lower part of the right ascending root.

The *common carotid artery* is the portion of the ascending root comprised between the third and fourth arches.

The *external carotid artery* is the modified upper part of the ascending root, – that is to say, the part of the ascending root above the third arch.

The *internal carotid artery* has long been known to present two portions, the first portion being the modified third arch, and the second portion being the modified upper part of the descending root, in which the current of blood has been reversed. It is now stated that there is a third or terminal portion of the artery formed by a branch given off from the back part of the first aortic arch.

The *subclavian artery* consists of three portions on the right side and two on the left. On the right side there is a first portion formed by the right fourth arch.* For the remainder of the right artery, and the whole of the left artery, the following developmental processes present:—

The two primitive descending aortæ give off a series of lateral or intersegmental branches, or, morphologically, and as Prof. Macalister calls them, "intercostal arteries." Of this series of "intercostal" arteries, one passes out on either side between the first rib and the costal process of the last cervical vertebra. This artery, as the other intercostal arteries, divides into a posterior or dorsal branch, and an anterior or proper intercostal branch. The posterior or dorsal branch becomes either the vertebral artery [Schäfer], or the superior intercostal [Macalister]. The anterior or proper intercostal branch becomes the portion of the subclavian artery external to the collateral named, – that is, practically,

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* This first portion of the right subclavian artery is the homologue, on the right side of the body, of, on the left side, the third portion (embryologically) of the arch of the aorta: these vessels are developed from the corresponding aortic arches (fourth arches). One might be tempted to refer, in confirmation of the homology alluded to, to the fact that both arteries are embraced by the inferior or recurrent laryngeal nerves. This would be falling, however, into a gross morphological error. It is, morphologically, the two fifth arches, not the two fourth arches, that are embraced by the inferior or recurrent laryngeal nerves. But the fifth right arch, becoming obliterated, is replaced on the right side, in reference to the relation referred to, by the fourth right arch, – that is to say, the right subclavian artery. In regard to the left side of the body, it will be noticed that the left recurrent laryngeal nerve embraces the arch of the aorta on the *left side* of the ductus arteriosus, – *ergo*, changes of position resulting from the retrocession of the heart into the thorax being allowed for, it embraces the distal portion of the left *fifth* arch, the *ductus arteriosus*. See further Section IV. (The recurrent course of the inferior laryngeal nerves is explained by the gradual retrocession of the heart and great vessels from the neck into the thorax.)

the third portion of both fully evolved subclavian arteries. The portion of the subclavian artery *internal* to the collateral branch named, – that is, practically the whole of the first and second portions of the left artery, and such parts of the first and second portions of the right artery as are not formed by the fourth arch, – is then developed from the common trunk of the above-named "intercostal" artery.*

IV.

Abnormalities.

First or Pericardial Portion of the Aortic Arch, & Pulmonary Artery.

The aorta and pulmonary artery may communicate more or less freely through deficiency of the septum between them; they may be united into one common trunk, in connection with a single heart, like that of fishes; they may be transposed, the pulmonary artery communicating with the left, and the aorta with the right ventricle.

Extra-Pericardial Portion of the Aortic Arch.

There may be a *complete double aortic arch*. Here the right fourth arch and the lower part of the right descending root have developed along with the corresponding structures of the left side. The correctness of the remarks in the foregoing footnotes will here be apparent: The aorta bifurcates into two originally equally important trunks.

There may be a *complete transposition* of the arterial and venous sides of the heart, and of the aortic arch & pulmonary artery and great veins of the root of the neck (dextrocardia), as in birds, – which condition may be accompanied by a similar transposition of the viscera generally (situs inversus).

Without any other abnormality, there may be a *simple change of side of the aortic arch*, the vessels arising from the arch being, from before backwards and from left to right, a *left innominate*, a *right common carotid*, and a *right subclavian*, – the recurrent laryngeal nerve further forming its sling round the aorta on the right side and round the subclavian artery on the left. Here the right fourth arch and right descending root have developed instead of the corresponding structures of the left side.

Descending Aorta and Aberrant Subclavian Artery.

The right subclavian artery is not unfrequently detached from the early

* The lateral portions of the embryo, – and the limbs, – being of late growth, the dorsal intercostal branches of the "intercostal" arteries are antecedent to the proper intercostal branches. These are then sometimes described, therefore, as being given off from the former. In particular, the intercostal artery which goes to form part of the adult subclavian artery is described by Prof. Schäfer as a branch of the vertebral. "The vertebral artery," says Prof. Schäfer, "gives off from its commencement a branch for the upper extremity, which branch subsequently exceeds the parent trunk in size, and forms part of the subclavian, the name being extended to what was originally the commencement of the vertebral." Prof. Macalister gives practically the same account, but applied to the superior intercostal. It will be seen that on the left side the subclavian is entirely an artery of new formation, while on the right side it is partly so, and partly one of more ancient date.

part of the arch, and seen to arise from the back of the descending portion. Such an artery is termed "*aberrant.*" It is the fourth branch given off from the aorta, the three previous branches being in succession the right common carotid, the left common carotid, and the left subclavian. The artery reaches its normal situation on the first rib between the scaleni muscles by passing behind the aortic arch, the trachea, and the œsophagus,

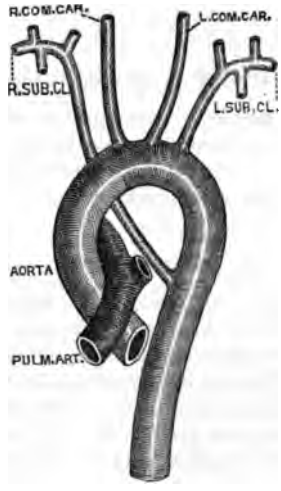

FIG. 21.—DIAGRAM SHOWING THE ORIGIN OF THE DISPLACED SUBCLAVIAN ARTERY. (QUAIN.)

and it is not looped round by the inferior laryngeal nerve, which nerve in this case passes directly to the larynx. Here the right fourth arch has atrophied, and it is the lower part of the right descending root that conveys the blood to the terminal portion of the subclavian artery. The left fourth arch being absent, the inferior laryngeal nerve is not drawn down out of its course to the larynx.*

An easily explained approach to the above condition may also present. With

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* The "arteria aberrans" of adult human anatomy, and its occasionally enlarged condition, may here be referred to. This artery is usually a very small branch arising from the under surface of the right subclavian, or from the right superior intercostal [costo-cervical trunk, Macalister], which descends behind the œsaphagus, either to be lost in the connective tissue in front of the vertebræ, or, when it is larger than usual, to join the thoracic aorta below the ductus arteriosus. This artery is the remains of the lower part of the right descending root. When, as sometimes occurs, the usual commencement of the right subclavian artery, – the fourth right arch, – becomes obliterated, this channel dilates, and constitutes the main trunk supplying the upper limb, – which trunk arises *leftmost* from the arch of the aorta, and passes behind the trachea and œsophagus. In such cases there is necessarily a direct, not a recurrent, course of the right inferior laryngeal nerve [Macalister].

an aberrant subclavian artery, the *right vertebral* artery may arise from the *innominate:* It is a persistent, but slightly developed right fourth arch, that gives off this branch. Here the inferior laryngeal nerve takes its usual recurrent course.

These abnormalities may occur on the left side in connection with a right aortic arch.

The case of the former abnormality so occurring, is particularly interesting. The left subclavian artery arises from the lower and back part of a right aortic arch by means of a kind of pouch which represents the junction of the persistent primitive dorsal aorta with the obliterated ductus arteriosus. Here the left recurrent laryngeal nerve loops round the arch thus constituted. Associated with this abnormality are numerous varieties in the closure of the ductus arteriosus.

Varieties in Number and Position of the Branches arising from the Arch of the Aorta.

"These branches may all be collected into one trunk, or they may arise separately from the aorta to the number of six. In the rare case of one trunk, we may suppose the origins of the right and left arches to be united, and the fourth left arch to be much shortened, thus bringing all the branches together, as naturally occurs in the horse, forming what is called the anterior aorta.

"The cases of two vessels from the arch may be of two kinds: in the one, which is the commonest of all the varieties of aortic vessels in man, and is the normal condition in most apes, the left carotid is united with the innominate artery into a common stem; in the other, which is exceedingly rare, there are two innominate trunks, as in the bird.

"Three is the normal number of branches arising separately from the arch in man and some other mammals. There is, however, a rare form of variety in which the number is the same, and in which, as occurs naturally in some cetacea, the subclavians are both separate vessels, and the two carotids spring from a common stem in the interval between them.

"The commonest form of the condition in which there are four vessels taking origin from the aortic arch is that in which the left vertebral artery arises between the left carotid and subclavian arteries. The origin of four large arteries in the order right carotid, left carotid, left subclavian, and right subclavian, has just been referred to. A much rarer form is that in which the vessels arising from the arch are successively the right subclavian, the right carotid, the left carotid, and the left subclavian arteries.

"The number of five arteries proceeds from the separate origin of the right subclavian and left vertebral arteries.

"In the case of six vessels proceeding from the single arch, of which there are a few instances described, the vessels were in the following order, which is that which might be anticipated from the mode of development, viz.: right subclavian, vertebral and carotid, left carotid, vertebral and subclavian arteries." [Quain's "Anatomy," 10th ed.]

THE AORTA DESCRIBED EMBRYOLOGICALLY.

The origin of the Aorta from the "ascending root," left "fourth arch," and "descending root," as above described, is taken by "advanced" writers of to-day to warrant a re-description of the vessel less striking at first sight, but really more remarkable, for its boldness, than the re-description of the viscoral organs according to His' plaster of Paris models.

The new description of the Aorta, as divided into "Ascending Aorta," "Transverse Aorta," or "Arch," and "Descending Aorta," found in the latest editions of several text-books, is given below. But it should be noted at once that the "Arch" described from the embryological standpoint is but a portion (the central portion) of the Arch as usually described; and, further, that it is not the Arch as yet referred to, or ever likely to be referred to, either by the physician or surgeon, who treats, say, the aneurism, or by the pathologist, who notes the site of the atheromatous lesion. Here is simply a distinct and undeniable instance of the encroachment of the scientist upon ground of which the profession alone are competent to judge. Writes Prof. Macalister: "Morphology . . . . has given Anatomy a new aspect." This it undoubtedly has; but through professional supineness, and for a time only, it is believed. There is no escape from the dilemma: "You must found your anatomy on the facts of the dissecting room, or on embryology and morphology—on what is visible and tangible, or on what is not so. In the former case you get a practical knowledge of anatomy—in the latter you get an abstract and theoretical knowledge; in the former case you get anatomy familiar to the eye and the finger—in the latter case you get anatomy as a mental conception; in the former case you get the anatomy of the *surgeon*—in the latter case you get the anatomy of the *scientist*." (See "Old and New Schools of Anatomy," page 25.) Nor is there any escape from this authoritative conclusion: "Embryology and morphology are most interesting, but they do *not* fit a man for the practice of his profession." (See letter of "A Former Teacher of Anatomy," page 321.)

There is with many a natural tendency to blindly accept all later views and statements as necessarily and properly superseding earlier oner. It is hoped that the foregoing examination of the basis on which, in this instance, – and this is but one instance among many, – the newer views and statements rest, may at least transfer the question of their acceptance to higher ground, – that of the previous question, whether the said basis is a desirable one, or not, on which to found anatomy for *Medical* men.*

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* It is for similar reasons that we must now have *sacral* and *coccygeal* aortæ, with new arterioles almost innumerable; that the external jugular vein must now begin at the mastoid process; that the internal jugular vein must end at the upper border of the thyroid cartilage; that the descendens noni nerve must no longer be a branch of the hypoglossal; that numerous muscles must be re-named, and several new ones created; that the description of the brain must be so re-modelled as to make it almost unrecognisable; &c., &c. In not one of the above instances are the requirements of practice in any way considered. These, indeed, are entirely sacrificed: We must no longer have a femoral ring

"The **Ascending Aorta** is about two inches in length. It commences at the upper part of the left ventricle, and on a level with the *lower border of the third costal cartilage behind the left half of the sternum*; it passes obliquely upwards, forwards, and to the right in the direction of the heart's axis, as high as the *upper border of the second right costal cartilage*, describing a slight curve in its course, and being situated, when distended, about a quarter of an inch behind the posterior surface of the sternum. This portion of the aorta is contained in the cavity of the pericardium, and, together with the pulmonary artery, is invested in a tube of serous membrane, continued on to them from the surface of the heart. The Ascending Aorta is covered at its commencement by the trunk of the coronary pulmonary artery and the right auricular appendix, and, higher up, is separated from the sternum by the pericardium. the right pleura, and anterior margin of right lung, some areolar tissue and the remains of the thymus gland; behind, it rests upon the root of the right lung and left auricle. On the right side, it is in relation with the superior vena cava and right auricle; on the left side, with the pulmonary artery."

"The **Arch**, or **Transverse Aorta**, commences at the *upper border of the second chondro-sternal articulation of the right side*, and passes from right to left and from before backwards, to the *left side of the lower border of the fourth dorsal vertebra*, behind. Its upper border is usually about an inch below the upper margin of the sternum. Its anterior surface is covered by the pleuræ and lungs and the remains of the thymus gland, and crossed towards the left side by the left pneumo-gastric and phrenic nerves, and superior cardiac branches of the left sympathetic, and by the left superior intercostal veins. Its posterior surface lies on the trachea just above its bifurcation, on the great, or deep, cardiac plexus, the œsophagus, thoracic duct, and left recurrent laryngeal nerve. Its upper border is in relation with the left innominate vein; and from its upper part are given off the innominate, left common carotid, and left subclavian arteries. Its lower border is in relation with the bifurcation of the pulmonary artery, the remains of the ductus arteriosus, which is connected with the left division of that vessel, and the superficial cardiac plexus; the left recurrent laryngeal nerve winds round it from before backwards, whilst the left bronchus passes below it."

"The *Descending Aorta* is divided into two portions, the thoracic and the abdominal, in correspondence with the two great cavities of the trunk, in which it is situated."

"The **Thoracic Aorta** commences at the lower border of the fourth dorsal vertebra on the left side, and terminates at the aortic opening of the diaphragm, in front of the last dorsal vertebra. At its commencement, it is situated on the left side of the spine; it approaches the median line as it descends, and, at its termination, lies directly in front of the column. It is in relation in front, from above downwards, with *the left pulmonary artery, the left bronchus*,† the pericardium, and the œsophagus; behind, with

(see p. 323); and, *per contra*, we must have a perineal ledge, made to look like a triangular piece of cardboard with a round hole cut in the middle of it. It must be plain to all whose eyes are open, that the effort is being made to subordinate anatomy, and this no longer the anatomy taught by dissection, to a general study of animal (and vegetable) life, in itself and in its origins. Is this the kind of Anatomy we want as medical men, except, – the tables being turned, – by way of technical accomplishment, or more or less decorative scholarship?

† It will be seen that what is usually described as the descending portion of the arch of the aorta is merged into the "thoracic aorta."

the vertebral column and vena azygos minor; on the right side, with the vena azygos major and the thoracic duct; on the left side, with the left pleura and lung. The œsophagus, with its accompanying nerves, lies on the right side of the aorta above; but at the lower part of the thorax it gets in front of the aorta, and close to the diaphragm is situated to its left side." (Gray's Anatomy, 13th Edition.)

Abdominal Aorta.—*Vide* Tablets, p. 126.

Sacral & Coccygeal Aortæ.—*Vide* p. 152d.

"**The Cardiac Rings.**—The position of the various orifices is as follows:—The *pulmonary orifice* is situated in the upper angle formed by the articulation of third left costal cartilage with the sternum; the *aortic orifice* is a little below and internal to this, behind the left border of the sternum, close to the articulation of the third left costal cartilage to this bone. The *left auriculo-ventricular opening* is behind the sternum, rather to the left of the median line, and opposite the fourth costal cartilages. The *right auriculo-ventricular opening* is a little lower, opposite the fourth interspace, and in the middle line of the body." (Gray's Anatomy, 13th Edition.)

"**Surface Form.**—In order to show the extent of the heart in relation to the front of the chest, draw a line from the lower border of the second left costal cartilage, one inch from the sternum, to the upper border of the third right costal cartilage, half an inch from the sternum. This represents the base line, or upper limit of the organ. Take a point an inch and a half below, and three-quarters of an inch internal to the left nipple,—that is, about three and a half inches to the left of the median line of the body. This represents the apex of the heart. Draw a line from this apex point, with a slight convexity downwards, to the junction of the seventh right costal cartilage to the sternum. This represents the lower limit of the heart. Join the right extremity of the first line,—that is, the base line,—with the right extremity of this line,—that is, to the seventh right chondro-sternal joint,—with a slight curve outwards, so that it projects about an inch and a half from the middle line of the sternum. Lastly, join the left extremity of the base line and the apex point by a line curved slightly to the left." (Gray's Anatomy, 13th Edition.)

The first of the two foregoing paragraphs is reproduced with pleasure as giving the data of exact research as opposed to those resulting from the ordinary dissection of the cadaver.* With reference to the second paragraph, however, it is respectfully asked, *Is this Anatomy?* It is plain that it is not the "anatomy of the human body as taught by dissection,"—"the anatomy of the cutaneous structures, then the different layers of

* The inference may perhaps be drawn that it is conceded in the above remark that precise research should take precedence of ordinary dissecting. This is by no means the Author's view. Though all facts, that are *facts*, must of course be fully accepted, yet the method by which they are established is often of primary importance to the attainment of that personal knowledge which alone is of value in such an essentially applied science as Medicine. It is quite possible to lose by any precision in excess of what is needed, if for the attainment of the same, such methods of research or verification have to be given up which are alone within the reach of the individual learner. This appears to be the case, at present at least, with such anatomical studies as are conducted by means of frozen sections.

muscles with their appertaining vessels and nerves examined in succession" (Ellis). Neither is it the practical or applied anatomy "to help surgeons in their daily work" (Luther Holden); since there is nothing but what allows the light-hearted youth to simply learn it off by rote to "reproduce at the next examination," and afterwards totally forget it. To the Author's mind it is regrettable that there should be presented as anatomy, without a distinctly qualifying epithet, anything that is not simply what, irrespective of pre-formed opinions or special objects, is to be seen and handled in the dissecting room. The Author must again express the hope that he may not be misunderstood. He is as much in favour of "scientific" anatomy, and of "applied" anatomy, as anyone can be. But he would press, on the strength of the deepest conviction, that such aspects of the subject be brought out in separate treatises, on the model, say, on the one hand, of Bland Sutton's "Ligaments," and, on the other, of Holden's "Landmarks" (or on the lines of his own little book of "Aphorisms"); and that "Dissectional" anatomy be allowed to stand alone, unmixed with anything not based upon the personal work of the learner with his scalpel and forceps. This is, he submits, the one form of anatomy on which, for medical men, everything else should rest.

Altered Levels.

The trachea bifurcates opposite the *fourth* dorsal vertebra.
The right bronchus enters the lung opposite the *fifth* dorsal vertebra.
The left bronchus enters the lung opposite the *sixth* dorsal vertebra.

DEVELOPMENT OF THE CENTRAL VENOUS SYSTEM.

The central venous system results from the metamorphoses of the cardinal, and of the vitelline & umbilical veins.

Cardinal Veins.

These are four symmetrical and parallel veins, two superior (jugular, or primitive jugular veins) and two inferior (or cardinal veins proper), which lie on either side and along the whole length of the spinal column, and converge towards the heart, – those of either side joining to form two short trunks, the canals of Cuvier, which open into the auricular portion of the heart on either side of the vitelline or omphalo-mesenteric vein.

The cardinal veins receive numerous lateral branches, or "intercostal" veins, from either side of the body.

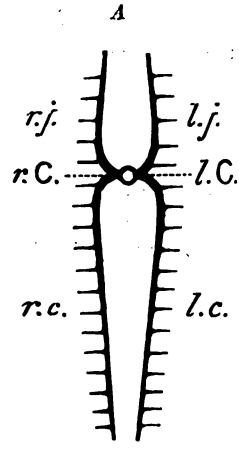


FIG. 22.—DIAGRAM OF THE CARDINAL VEINS.

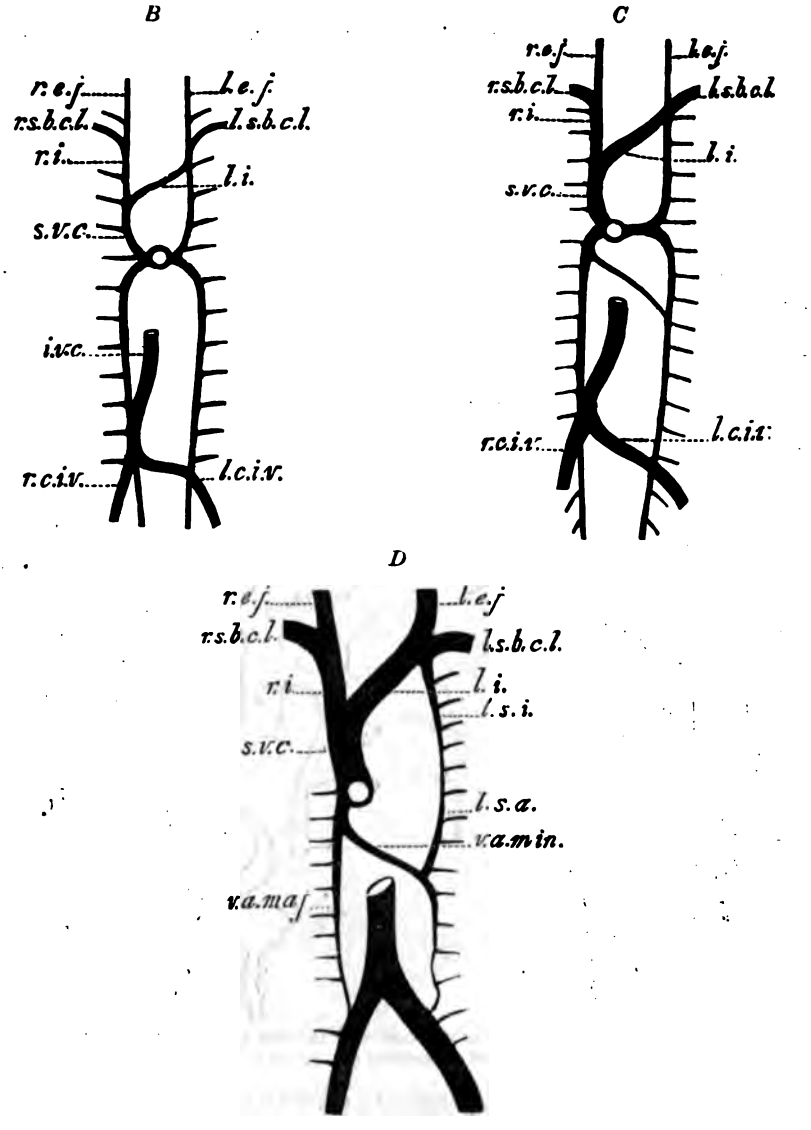
r.j., right upper cardinal vein, or right jugular; *l.j.*, left upper cardinal vein, or left jugular; *r.c.*, *l.c.*, right and left cardinal veins; *r.C.*, *l.C.*, right and left ducts of Cuvier.

When the upper limbs develop, two of these veins enlarge, and become the *subclavians*. (See Diagrams *B*, *C*, and *D*.)

The portions of the superior cardinal, or primitive jugular, veins situated above the subclavians become the external jugular veins.*

The portion of the right primitive jugular vein below the subclavian becomes the *right innominate vein*, superiorly, and the *superior vena cava*, inferiorly. The corresponding portion of the left primitive jugular contracts into the *left superior intercostal*.

* At this stage there is no internal jugular vein. It is the external jugular vein which first, through the mastoid foramen, drains the blood from the lateral sinus; and it is through the gradual closure of the mastoid foramen, and the consequent decrease in size of the external jugular vein, that the internal jugular vein subsequently develops, and, joining the lower part of the primitive jugular, comes in a large measure, to take the place of the external jugular.



FIGS. 23, 24, & 25.—DIAGRAM OF THE EVOLUTION OF THE CARDINAL VEINS.

r. sbcl., *l. sbcl.*, right and left subclavian veins; *r. e. j.*, *l. e. j.*, right and left external jugular veins; *r. i.*, right innominate vein; *l. i.*, left innominate vein; *s. v. c.*, superior vena cava; *i. v. c.*, inferior vena cava.

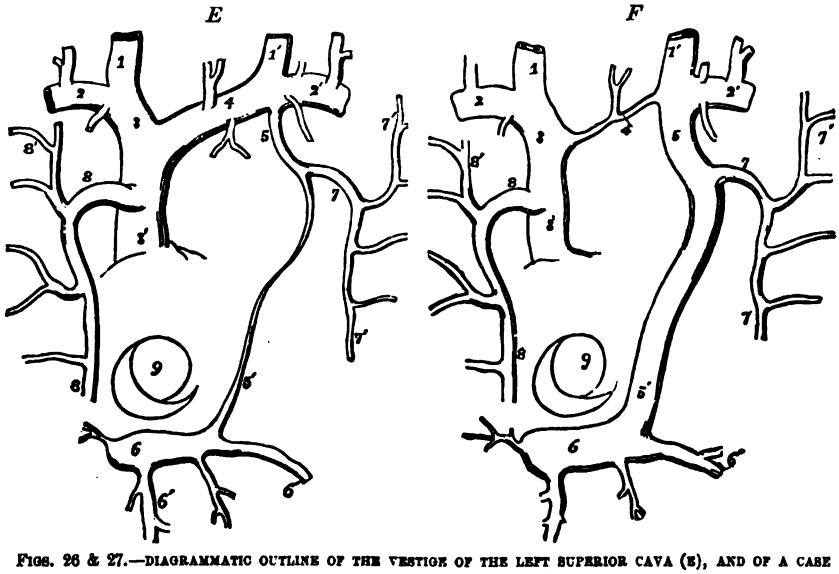
v. a. maj., *v. a. min.*, vena azygos major, vena azygos minor; *l. s. a.*, left superior azygos vein; *l. s. i.*, left superior intercostal vein; *r. c. i. v.*, *l. c. i. v.*, right and left common iliac veins.

The *left innominate* vein is at first a small communicating branch which descends obliquely from the left primitive jugular just below its junction with the subclavian, to the middle part of the right primitive jugular. This communicating branch enlarges, while the part of the left primitive jugular situated below it diminishes. The former then conveys towards the heart, first the greater part, then the whole of the venous blood from the left side of the head & neck and from the left upper limb, and takes the place of the latter. – The latter, its communication with the auricle being interrupted, and the course of the blood in its interior being reversed, then becomes, as above stated, the *left superior intercostal.*

The portion of the right primitive jugular vein comprised between the right subclavian & the newly formed left innominate, now becomes the *right innominate.*

The portion of the right primitive jugular vein situated below the left innominate becomes (with the corresponding duct of Cuvier) the *superior vena cava.*

The right inferior cardinal vein forms the *vena azygos major*, and the *lower part of the inferior vena cava.*



FIGS. 26 & 27.—DIAGRAMMATIC OUTLINE OF THE VESTIGE OF THE LEFT SUPERIOR CAVA (E), AND OF A CASE OF ITS PERSISTENCE (F). (QUAIN.)

[The two views are from the front, the heart being supposed to be removed or seen through.]

1, *1'*, external jugular veins; *2*, *2'*, subclavian veins; *3*, right innominate; *3'*, right or regular superior cava; *4*, left innominate, normal in *A*, rudimentary in *B*; in *A*, *5*, the opening of the left superior intercostal vein into the left innominate, *5'*, the left duct of Cuvier with the vestige of the left superior cava; in *B*, the left superior vena cava abnormally persistent; *6*, coronary sinus; *7*, superior intercostal vein of the left side (left superior cardinal); *8*, vena azygos major (right lower cardinal); *7'*, *8'*, some of the upper intercostal veins; *9*, opening of the inferior cava with the Eustachian valve.

The *upper part of the inferior vena cava* is formed by a communicating branch which joins the latter to the vitelline vein

A communicating branch which passes from the left lower cardinal to the right lower cardinal forms the *vena azygos minor*. The upper part of the left lower cardinal then becomes the *left upper azygos*.

The left duct of Cuvier disappears in the main, its central portion remaining, however, as the coronary sinus (Fig. 4).

Occasionally the left duct of Cuvier and the lower part of the left upper cardinal persist, forming a left superior vena cava, – in which case the left innominate vein is quite small or vestigial. This arrangement, and its homological derivation from the normal arrangement, are well illustrated in the two preceding woodcuts. There may persist a mere vestige only of the left superior vena cava, forming the vestigial vein of Marshall.

Some morphological interest attaches to both internal iliac veins and to the *right* common iliac. These are remains of the terminal part of the two inferior cardinals. The *left* common iliac vein is merely a transverse anastomosis between the lower part of the two inferior cardinals, similar, in the lower part of the body, to the left innominate vein, in the upper part. Just as there were originally two superior venæ cavæ, so there were originally two inferior venæ cavæ, formed, in their lower part, out of the middle part of the two inferior cardinals. As does the left superior vena cava, so does the left inferior vena cava disappear, through the formation of a transverse anastomosis, – though it also leaves sometimes a vestige behind it. This arrangement gives the key to various rare abnormalities, and explains why the spermatic, suprarenal, and inferior phrenic veins open into the inferior vena cava directly, on the right side, and indirectly only, on the left side. The external iliac veins, with the veins of the lower limb proper, are veins of new formation.

Vitelline and Umbilical Veins, and First Portal Circulation.

The left or persistent vitelline or omphalo-mesenteric vein opens at first into the common auricle between the ducts of Cuvier, and then, after the separation of the two auricles, into the right auricle between the same ducts, which latter have now become transformed, the right one into the termination of the *superior vena cava*, and the left one into the *coronary sinus*.

FIG. 28.—DIAGRAM OF THE FIRST PORTAL CIRCULATION.

l. vit. v., left or persistent vitelline or omphalo-mesenteric vein.

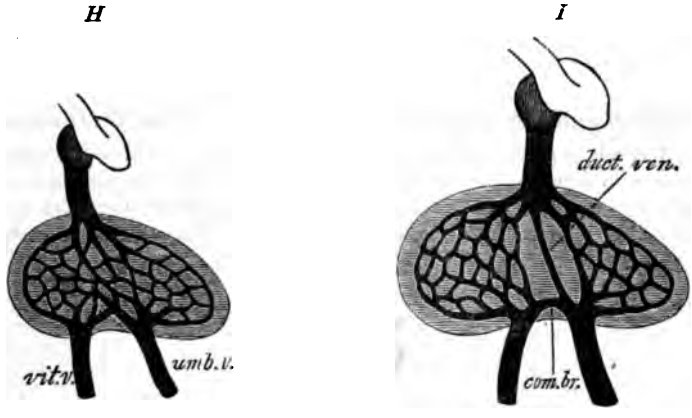
A little below the heart, it receives the umbilical vein (unimportant at this stage), and becomes surrounded by the liver, in the interior of which it breaks up into a capillary plexus (venæ hepaticæ *adheventes* & *reheventes*) – the branches of which plexus again unite into venous trunks, the *hepatic veins*, which latter open into what

has here been called the "*common inferior caval trunk.*"* – The portal vein is now constituted in its *first or primitive form* (Diagram *G*).

This first portal vein receives its blood *mainly, at first, from the umbilical vesicle:* – The umbilical vesicle is now at its maximum, while the intestine and abdominal viscera are still undeveloped: therefore the *omphalic* branches of the omphalo-mesenteric veins, *i.e.*, the branches which proceed *from the umbilical vesicle*, predominate over the *mesenteric* branches. Subsequently, as, on the one hand, the intestine and abdominal viscera develop, while, on the other hand, the umbilical vesicle becomes exhausted, so also does the relative importance of the two first sources of the portal blood become reversed: – After a while the supply from the *mesenteric* branches comes to exceed the supply from the *omphalic* branches.

Vitelline and Umbilical Veins, and Second Portal Circulation.

The allantoic vesicle now appears. It carries out with it the two umbilical arteries, and brings back the two umbilical veins, of which the right one, however, soon disappears.



FIGS. 29 & 30.—DIAGRAM OF THE SECOND PORTAL CIRCULATION.

vit. v left vitelline vein; *umb. v.*, umbilical vein; *duct. ven.*, ductus venosus; *com. br.*, communicating branch between umbilical & vitelline veins.

The left or persistent umbilical vein joins with the left or persistent

* "Common Inferior Caval Trunk."– The two statements, sufficiently correct in ordinary human Anatomy, namely, – "*that the hepatic veins open into the inferior vena cava*," and "*that the inferior vena cava opens into the auricular portion of the heart*," – are scarcely correct in embryology. The correct statement is that both the hepatic veins and the inferior vena cava open into the *left or persistent vitelline* or *omphalo-mesenteric* vein, *which latter vein it is that opens into the auricular portion of the heart.* – The name "COMMON INFERIOR CAVAL TRUNK" is here given to the portion *of the left or persistent vitelline* or *omphalo-mesenteric vein* above the opening into it of the above-named vessels. It is believed that the adoption of this term would lead to greater accuracy of description than generally prevails, without entailing the disadvantage of a too cumbrous description.

omphalo-mesenteric vein in the substance of the liver,* and takes, as the allantois increases in size while the umbilical vesicle diminishes, a more and more important share in the formation of the portal capillary plexus. – It comes to supply the left lobe entirely, and sends a *large communicating branch to the omphalo-mesenteric vein*, which branch partly supplies the right lobe (Diagrams *H* and *I*).

There are now *two portal veins.*

Vitelline and Umbilical Veins, and Permanent Portal Circulation.

The liver soon receives more blood from the umbilical vein than from the vitelline, and receives more blood than it requires. Its vessels are then relieved as follows (Diagrams *I* and *J*) : –

A second communicating branch, the *ductus venosus* (Diagram *I*), formed by the dilatation of one of the hepatic capillaries, joins the umbilical vein to the "common inferior caval trunk," and conveys part of the blood from the former directly to the inferior vena cava, and to the heart.

J

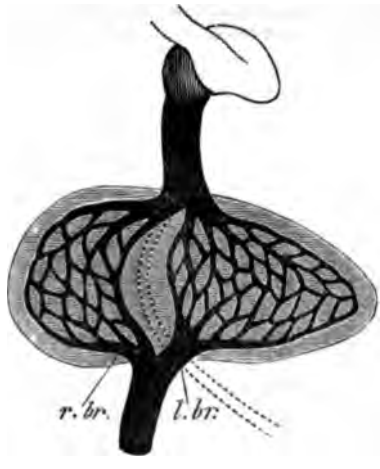


FIG. 31.—DIAGRAM OF THE PERMANENT PORTAL CIRCULATION.

rb., l.b., right and left branches of the portal vein.

At birth, both the *trunk of the umbilical vein* and the *ductus venosus* become obliterated, but the *branches of distribution of the umbilical vein*, and its *communicating branch* to the omphalo-mesenteric vein persist (Diagram *J*), – the circulation in the latter branch being, however, *reversed.*

* The umbilical vein first opens into the vitelline vein *above* the liver. But through the development of a collateral branch below the liver, and the atrophy of the upper part of the original trunk, the umbilical vein subsequently comes to open into the vitelline vein *below* the liver.

The portal system is then definitely constituted by: –

1. The *mesenteric branches and trunk of the left or persistent vitelline or omphalo-mesenteric vein*, – the small portion of the trunk contained in the liver becoming the *right branch of bifurcation*, or the branch to the right lobe.

2. The *branches of distribution of the umbilical vein*, and the *communicating branch between this vein and the omphalo-mesenteric*, which communicating branch becomes the *left branch of bifurcation* of the portal trunk, or the branch to the left lobe.

It is believed that the *separate* description of the three stages of the portal circulation will facilitate the study of this difficult subject.

The large veins that reach the fœtal auricle are first the left vitelline or omphalo-mesenteric vein, and the two ducts of Cuvier, and, later on, and indirectly, the umbilical vein and the inferior vena cava, both of which latter open into the left vitelline vein. All the above vessels open into what becomes the right auricle. After the differentiation of the common auricle, or atrium, into right and left auricles, the latter auricle receives the pulmonary veins.

In the early stages of cardiac evolution the above vessels open in groups, and not singly, into the corresponding auricle. The ducts of Cuvier and the vitelline vein open into the right auricle by means of a common stem, the bulbus venosus. It is by the expansion, later on, of the bulbus venosus, and by the consequent absorption of its walls into the auricular boundary, that the three openings (now the coronary sinus and the superior and inferior venæ cavæ) become separate and distinct. The same thing happens in connection with the four pulmonary veins, of which, even in the adult, the two left ones often terminate conjointly.

LIGAMENTS OF THE VERTEBRAL COLUMN.*

Interspinous & Intertransverse Ligaments, and Rectus Capitis Posticus Minor Muscle.

The above ligaments result from the regression of the muscles of same name. The muscles are found in the most movable portions of the spine, *i.e.*, in the cervical and the lumbar regions; elsewhere they are more or less replaced by the above-named ligaments. The *rectus capitis posticus minor* may be considered the uppermost and largest of the interspinous muscles.

Lateral Occipito-Atloid Ligament, and Rectus Lateralis Muscle.

The above are the continuation between the atlas and the occipital bone of the series of the intertransverse muscles. The highest anterior representative of the series remains fleshy, and forms the rectus lateralis muscle; the corresponding posterior representative becomes tendinous, and forms the above-named ligament. The intertransversales muscles are replaced by ligaments in the dorsal region, and usually more or less so in the lumbar region.

This may be the place to remark that the *rectus capitis posticus major* is the upper part of the spinalis colli, and that the *superior oblique* is the highest segment of the multifidus spinæ. The homology of the inferior oblique muscle is still unsettled.

Intervertebral Discs.

The central part of these represents the remains of the notochord. In many birds a little disc or meniscus of cartilage is found in this situation, thinned to perforation at its centre. The central perforation in the meniscus is traversed, in the chick, by a ligament, which contains the undoubted remains of the intervertebral portion of the notochord

Suspensory Occipito-Odontoid Ligament.

This is the modified sheath of the notochord as it passes from the odontoid process to the basi-occipital.

Odontoid Process of the Axis

Is the detached body of the atlas. The following reasons may be given in support of the statement: - The process is traversed by the notochord on its way to the basi-occipital and the basi-sphenoid. Between this process and the body of the axis there is, in the embryo, a well-marked swelling of the notochord; and in man, even up to an advanced age, a cartilaginous nodule may be found in the situation named; in many mammals an epiphysial plate develops in the same situation. The odontoid process

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* Condensed from Mr. Bland Sutton's "Ligaments: Their Nature and Morphology."

remains a separate ossification in chelonians, lizards, and crocodiles. Another point may be added: The neck of the odontoid process is embraced behind by the transverse ligament, the representative in the neck of the posterior conjugal ligament, and in front by the anterior arch of the atlas, which represents two rudimentary ribs joined by an ossified anterior transverse ligament. (See below.)

Sutton's Anterior and Posterior Conjugal Ligaments of the Ribs.

Are well marked in the human fœtus, and are permanent in many mammals, including the seal, the horse, lion, dog, rabbit, &c. They are strong rounded bands connecting the corresponding ribs of each side, and encircling the intervertebral discs in front and behind. In the human adult, the anterior conjugal ligament becomes the middle fasciculus of the stellate or anterior costo-vertebral ligament; while the posterior one becomes the interosseous costo-vertebral ligament.

The sub-vertebral wedge-bones, hypapophyses, or intercentra, found between the bodies of the lumbar vertebræ in the mole, and which form a continuous series between the vertebral centra in the sphenodon, are ossifications of these anterior conjugal ligaments of the ribs.

Transverse and Check Ligaments of the Atlo-Axoid and Occipito-Odontoid Articulations.

Both these are repetitions of the posterior conjugal ligaments above referred to.

Anterior Arch of the Atlas.

This consists of two rudimentary ribs joined together by an ossified anterior conjugal ligament: – That the front part of the lateral masses of the atlas consists of two rudimentary ribs cannot be doubted: it corresponds to the anterior part of the other cervical transverse processes. The conclusion that these ribs are joined as above stated results from a consideration of the sub-vertebral wedge-bones or hypapophyses of the mole and sphenodon above alluded to.

EXPLANATION OF FIGURES NOT FULLY EXPLAINED IN THE TEXT.

(THORAX.)

FIG. 460.—THE RIGHT AND LEFT PHRENIC NERVES. (Hirschfeld.)

(1, 1, 1) The phrenic nerves, showing their origin from the third, fourth, and fifth cervical nerves (from the third through the communicans cervicis). The nerve is seen passing down in front of the scalenus anticus, subclavian artery, and root of the lung, lying external, on the right side, to the right innominate vein & superior vena cava, and then running by the side of the pericardium, covered by the pleura, to the diaphragm.

FIGS. 376 & 478.—DISTRIBUTION OF THE RIGHT PNEUMOGASTRIC, SYMPATHETIC, AND OTHER NERVES. (Hirschfeld.)

1, eyeball, with part of sclerotic coat removed, showing the ciliary nerves and ciliary muscle; 2, branch of third nerve to inferior oblique, with short or motor root of lenticular ganglion; 3, 3, 3, the three primary divisions of the fifth nerve, with their connections with the following ganglia, namely, 4, ophthalmic, 5, spheno-palatine, 6, otic, 7, submaxillary; 9, 6th nerve; 10, facial nerve, with the motor roots to the spheno-palatine and otic ganglia; (11) glosso-pharyngeal nerve; 12, pneumogastric nerve; (14) spinal accessory nerve; (15) proximal portion of divided hypoglossal nerve: its distal portion is seen on the anterior surface of the hyoglossus muscle; 16, loop between the two first cervical nerves; 17, middle primary cord of brachial plexus; 18, an intercostal nerve; (21) superior cervical ganglion of the sympathetic: this is seen to give off an ascending branch running up on the internal carotid artery, and dividing to form the carotid and cavernous plexuses; 22, communication with Jacobson's nerve; 23, sympathetic root of Meckel's ganglion; 25, sympathetic root of the lenticular ganglion; 27, junction with two first cervical nerves; (28) inferior ganglion of pneumogastric, or ganglion of the trunk; (29) superior laryngeal nerve; 30, its external branch; 31, 38, 39, superior, middle, and inferior cardiac nerves; (32, 33, 37, 38) cord of sympathetic, with the middle and inferior cervical ganglia; (35) inferior or recurrent laryngeal nerve; 42, superficial cardiac plexus and ganglion of Wrisberg; 43, 44, posterior and anterior coronary plexuses; 45, first of the chain of thoracic ganglia of the sympathetic, with their communications, and the origins of the greater and lesser splanchnic nerves. A, right ventricle; B, arch of aorta, slightly pulled forward; C, D, E, F, G, innominate, subclavian (divided), inferior thyroid, and common and internal carotid arteries, with their sympathetic plexuses; L, trunk of the pulmonary artery: the right branch, divided, is seen emerging from beneath the aortic arch and passing behind the superior vena cava, M; O, the two pulmonary veins of the right side; *a*, *b*, *c*, *d*, lachrymal, sublingual, and submaxillary glands, and lateral lobe of the thyroid; *e*, trachea, with the right bronchus divided; *f*, œsophagus and œsophageal plexus.

FIGS. 377 & 479.—DISTRIBUTION OF THE LEFT PNEUMOGASTRIC, SYMPATHETIC, AND OTHER NERVES. (Hirschfeld.)

(1) Superior cervical ganglion of the sympathetic; 2, its ascending branch to the internal carotid artery going to form the carotid and cavernous plexuses; 3, communication with Jacobson's nerve; 4, 5, 6, sympathetic roots of Meckel's and the lenticular ganglia; 8, anastomosis with the two first cervical nerves; 9, 10, pharyngeal plexus; 11, superior cardiac nerve; 12, 13, cervical cord and middle cervical ganglia; 14, 15, 16, anastomoses of the latter with the cervical and recurrent laryngeal nerves, and the pharyngeal plexus; 17, middle cardiac nerve; (18, 20, 21) inferior cervical ganglion, with filaments accompanying the vertebral and subclavian arteries; 22, inferior cardiac nerve; 23, superficial cardiac plexus, with ganglion of Wrisberg; 24, 25, anterior and posterior cardiac plexuses; (26) pneumogastric nerve; (27, 27) recurrent laryngeal nerve; (28, 29, 30) ophthalmic, spheno-palatine, and otic ganglia. A, B, C, right ventricle, trunk of pulmonary artery, its right and left branches, and the ductus arteriosus; D, E, F, G, H, innominate, left common carotid, and external and internal carotid, and subclavian arteries; I, superior vena cava.

SUMMARY OF PRACTICAL POINTS.

(THORAX AND BACK.)

Sternum.—Behind the first piece of the bone we find the *left innominate vein*, behind which are the *innominate*, *left common carotid*, and *left subclavian arteries*, the *trachea*, and the *œsophagus*. Below the left innominate vein comes the *arch of the aorta*, the highest part of which lies an inch below the upper border of the sternum.

The *trachea divides* into the two bronchi opposite the articulation between the two first pieces of the sternum, below and behind the arch of the aorta.

The *innominate artery* runs along a line drawn from the middle of the above articulation to behind the right sterno-clavicular joint.

The *internal mammary arteries* run behind the costal cartilages half an inch from either side of the sternum.

The top of the sternum corresponds to the second dorsal vertebra; its lower extremity corresponds to the tenth.

Ribs.—The *second rib* corresponds to the articulation between the first and second pieces of the sternum; the *fifth*, to the lower border of the pectoralis major; the *sixth*, to the highest digitation of the serratus magnus usually visible in the axilla: the *two last* ribs can always be felt just external to the erector spinæ.

The *nipple* in the male lies in the fourth intercostal space, about four inches from the middle of the sternum.

Paracentesis pericardii is performed in the fourth or fifth intercostal space, just to the left of the sternum. *Paracentesis thoracis* is performed in the fifth or sixth intercostal space, a little above and in front of the lower angle of the scapula.

The *first, or ascending, portion of the arch of the aorta* commences behind the sternum, close to the lower border of the third left costal cartilage, and passes upwards and to the right behind the inner extremity of the second intercostal space to the upper border of the second costal cartilage of the right side, close to the sternum. The superior vena cava lies to its right, behind the inner extremity of the two first intercostal spaces.

The Vertebral Spines.—Can be felt from the sixth cervical downwards, the spine of the seventh cervical vertebra being the most prominent (V. prominens). The upper cervical spines, which lie in front of the ligamentum nuchæ, recede too much from the surface to be perceptible to the finger, except, possibly, the bifid extremity of the axis. The dorsal spines lie in the median furrow caused by the projection of the erectores spinæ. They do not lie on a level with corresponding rib and corresponding vertebral body; each lies on a level with the head of the rib and the body of the vertebra below. This is due to the obliquity of the dorsal spinous processes. The two lower dorsal spinous processes are less oblique, and tally pretty accurately with the heads of the corresponding ribs.

Correspondences of the Principal Spines, mainly according to Holden :—

Dorsal Spines.—4th. Bifurcation of trachea; aorta reaches spine. 5th. End of aortic arch; upper level of heart. 8th. Lower level of heart; central tendon of diaphragm. 9th. Œsophagus and vena cava perforate diaphragm, and former opens into stomach; upper extremity of spleen. 10th. Upper limit, posteriorly, of convex surface of liver. 11th. Lower extremity of spleen. 12th. Limit of pleura behind; aorta perforates diaphragm.

Lumbar Spines.—1st. Renal arteries; pelvis of kidney. 2nd. Superior mesenteric artery crosses intestine, and mesentery begins; receptaculum chili; termination of spinal cord. 3rd. Umbilicus. 4th. Division of aorta; highest part of crest of ilium.

Scapula.—Covers the ribs from the third to the seventh. The root of the spine is marked by a slight dimpling of the skin. It lies on a level with the third dorsal spine.

(*See practical questions at end of book.*)

THE MUSCLES OF THE BACK.

NOTE.—Few anatomists know much now-a-days of the deep muscles of the back,—the last to study them with any special care being the French anatomist, Cruveilhier. They are not difficult to dissect, however; and, for those who care for Anatomy, except for mere examinational purposes, they supply a most interesting study of serial homology. The figures, which, carefully examined in the light of the explanations given, will be found to lend the greatest aid to the dissection, are Figures 483, 484, 485, and 491. These, and several others, are taken (some with slight alterations) from the monumental work of Bourgery and Jacob, the distinguished forerunners of Hirschfeld and Leveillé in anatomical illustration.

MUSCLES of the BACK.

FIRST LAYER.

Trapezius – External occipital protuberance & inner third of superior curved line of occipital bone; ligamentum nuchæ & spinous processes of the last cervical & of all the dorsal vertebræ; supraspinous ligament.

Posterior border of outer third of clavicle, inner border of acromion; whole length of upper lip of posterior border of spine of scapula, and tubercle at outer part of smooth surface at its inner extremity. – S. by spinal accessory nerve & deep branches of cervical plexus.

Latissimus Dorsi – Spinous processes of the 6 or 7 lower dorsal vertebræ; by the posterior layer of lumbar aponeurosis, from the lumbar & sacral spines and the back part of outer lip of crest of ilium; from outer lip of crest of ilium for an inch or more in front of lumbar aponeurosis; from the last three or four ribs interdigitating with external oblique; sometimes by a few fibres from inferior angle of scapula.

Bottom of bicipital groove of humerus a little higher up than teres major by a broad flat tendon twisted upon itself. – S. by long subscapular nerve.

SECOND LAYER.

Levator Anguli Scapulæ – Posterior tubercles of transverse processes of the 3, 4, or 5 upper cervical vertebræ between splenius & scalenus medius.

Posterior border of scapula between spine & superior angle. – S. by one of the deep branches of the cervical plexus and by one of the supra-clavicular branches of the brachial plexus.

Rhomboideus Minor – Ligamentum nuchæ and spinous processes of 7th cervical & 1st dorsal vertebræ.

Posterior border of scapula opposite triangular smooth surface at root of spine. – S. by one of the deep branches of cervical plexus and by one of the supra-clavicular branches of the brachial plexus.

Rhmoboideus Major – Spinous processes of the 4 or 5 upper dorsal vertebræ and supra-spinous ligament.

Base of scapula between spine and inferior angle (Quain, Ellis), or rather into a tendinous arch attached to the triangular smooth surface at root of spine & to the inferior angle and connected to posterior border of scapula by a thin membrane (Gray). – S by one of the deep branches of the cervical plexus and by one of the supra-clavicular branches of the brachial plexus.

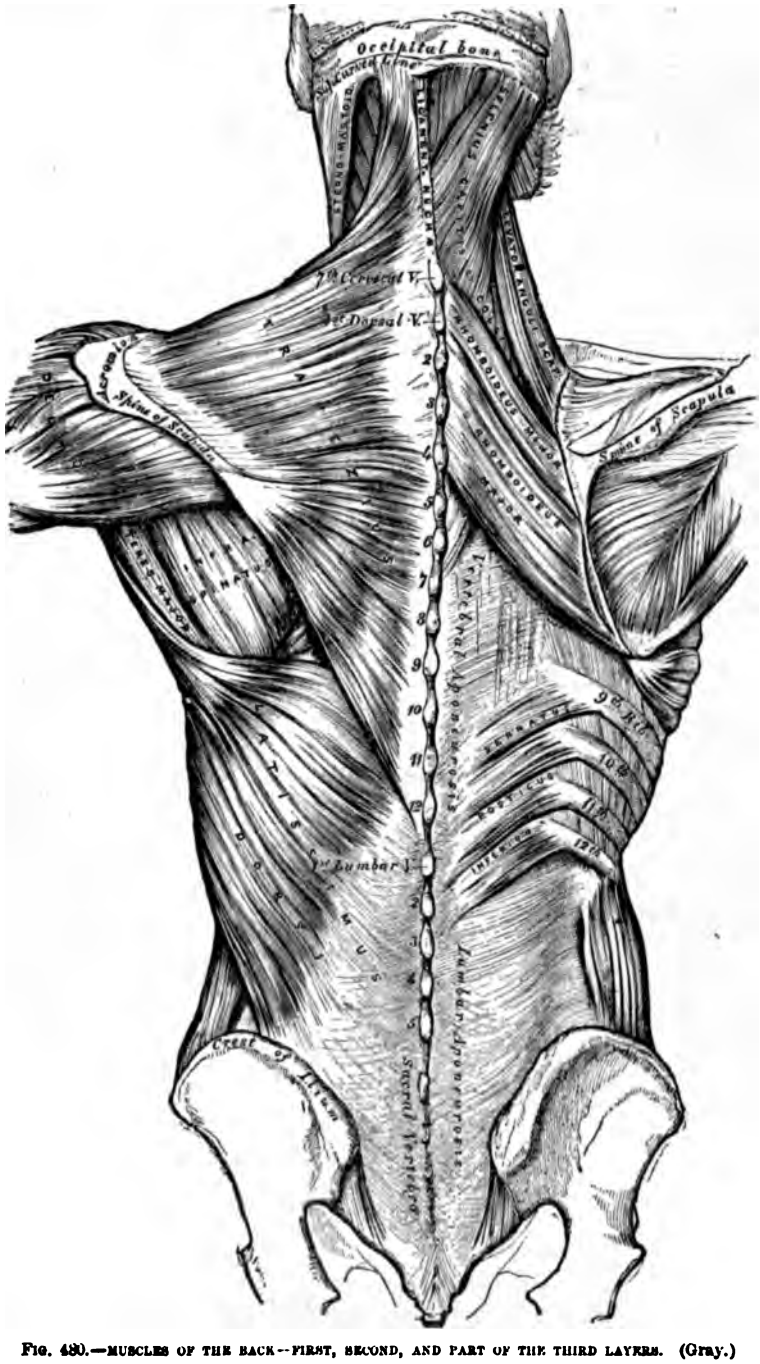

FIG. 480.—MUSCLES OF THE BACK—FIRST, SECOND, AND PART OF THE THIRD LAYERS. (Gray.)

THIRD LAYER.

Splenius – Lower half of ligamentum nuchæ and spinous processes of 7th cervical & si upper dorsal vertebræ.

SPLENIUS CAPITIS – Mastoid process and outer part of rough surface between sup erior & inferior curved lines of occipital bone.

SELENIUS COLLI – Posterior tubercles of transverse processes of the 2, 3, or 4 upper cer vical vertebræ. – S. by external branches of posterior divisions of cervical nerve

Serratus Posticus Superior – Ligamentum nuchæ and spinous processes of 7th cer vical & two or three upper dorsal vertebræ, and interspinous ligament.

Upper border of 2nd, 3rd, 4th & 5th ribs a little beyond their angle. – I by external branches of posterior divisions of lower cervical nerves.

Serratus Posticus Inferior – Spinous processes of the two last dorsal & 2 or 3 uppe lumber vertebræ.

Lower border of 4 lower ribs a little beyond their angle. – S. by externa branches of posterior divisions of lower dorsal nerves.

FIG. 481.—MUSCLES OF THE BACK—PART OF THIRD AND FOURTH LAYERS. (Bourgery and Jacob.)

1, Serratus posticus superior; 2, splenius; 3, complexus.

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FOURTH AND FIFTH LAYERS.—General View.

May be divided into:

LONG EXTENSOR MUSCLES of the BACK —

Lie beneath the trapezius, the latissimus dorsi & the superficial layer of the lumbar fascia, and beneath the splenius & a special layer of fascia in the neck, & the serrati muscles & the vertebral aponeurosis in the back.

They form a large elongated muscular and tendinous mass, narrow & principally tendinous and comprised in the sacral groove, below; enlarged & fleshy in the lumbar region, where it is only partly contained in the vertebral groove, and is tightly sheathed between the spines, laminæ, & transverse processes of the vertebræ and the posterior & middle layers of the lumbar fascia; expanded and complexly subdivided into almost innumerable muscular and tendinous fasciculi in the back; and, in the cervical region, partly exhausted, but continued upwards towards the head by numerous superadded fibres, & also strengthened by an additional muscle, the complexus.

The muscular & tendinous slips of which this mass is composed may be correctly and conveniently arranged into three main groups forming respectively the *ilio-costalis* or *sacro-lumbalis*, the *longissimus dorsi*, & the *multifidus spinæ*; the two former of which, joined together below, and increased by a few additional fibres, the spinalis dorsi, form the *erector spinæ* of the sacral & lumbar regions. (The term "*erector spinæ*" would be much better applied to the whole of the long extensor muscles of the back than to any one patr thereof).

Each of these three groups has additional fasciculi superadded to it, by which fasciculi it is continued to the head or to near the head, and by which it is increased in bulk & strength. Thus to the

ILIO-COSTALIS or SACRO-LUMBALIS are superadded the
Musculus accessories ad ilio-costalem (or ad sacro-lumbalem) & the *cervicalis ascendens*; — to the

LONGISSIMUS DORSI are superadded the
Transversalis colli & the trachelo-mastoid; — to the

MULTIFIDUS SPINÆ are superadded the
Semispinales dorsi & colli & the *rotatores spinæ*.

To these groups are also added a few accessory fasciculi, the *spinalis dorsi*, the *spinalis colli*, & the *biventer cervicis*.

SMALL MUSCLES of the SPINOUS & TRANSVERSE PROCESSES — Are the
Supraspinales, interspinales, intertransversales, & extensor coccygis.

SHORT POSTERIOR CRANIO-VERTEBRAL MUSCLES — Are the
Recti capitis postici major & minor, & the *Obliqui superior & inferior.*

. 482.—LONG EXTENSOR MUSCLES OF THE BACK; GENERAL VIEW.
(Bourgery and Jacob.)

n the *right side*, undisturbed:

1, erector spinæ; 2, 4, 5, ilio-costalis, musculus accessorius ad ilio-costalem, cervicalis ascendens; 3, 6, 7, longissimus dorsi, transversalis colli, trachelo-mastoid.

n the *left side*, dissected:

14, transversalis colli; 15, trachelo-mastoid; 16, complexus; 17, biventer cervicis.

(*See further expl.*, p. 268.)

MUSCLES OF THE BACK — 4th Layer.

The ilio-costalis or sacro-lumbalis & the longissimus dorsi arise by a common ori
the erector sp

ERECTOR SPINÆ – (*See* Fig. 482)—Posterior fifth of crest of ilium; and, by a b
thick tendon which covers and conceals the muscular fibres, from spine
sacrum, the spinous processes of the lumbar & three lower dorsal vertebræ,
posterior superior & posterior inferior iliac spines, and the series of emine
on the back of the sacrum, which represent the transverse processes of
verte

Divides opposite last rib into ilio-costalis or sacro-lumbalis and lon
mus dorsi. (*See* Fig. 482.)

ILIO-COSTALIS, or SACRO-LUMBALIS — Is the outer and smaller divisio
the foregoing, and is inserted into the

Angles of the six or seven lower ribs. (*See* Figs. 483, – 84, – 85, – 91.

Musculus Accessorius ad Ilio-costalem, or ad Sacro-lumbalem – (
internally to the foregoing) — Angles of the six lower ribs internally to ten
of ilio-costalis.

Angles of the six upper ribs. (*See* Figs. 483, 485.)

Cervicalis Ascendens – (Lies internally to the foregoing) — Angles of the fou
five upper ribs.

Posterior tubercles of transverse processes of 4th, 5th, & 6th cer
vertebræ. (*See* Figs. 483, 485.)

FIG. 483.—PROFILE VIEW OF THE SEPARATED FASCICULI OF THE ILIO-COSTALIS, AND OF ITS ACCESSORY MUSCLES. (Bourgery.)

The figure shows :—

(A), the *insertions* of the *ilio-costalis* into the angles of the six lower ribs, 1 to 1.

(B) the *origins* of the *musculus accessorius ad ilio-costalem* from the angles of the six lower ribs internally to (in the figure deeper than) the insertions of the principal muscle, 2 to 2. These origins are necessarily somewhat concealed by the insertions of the principal muscle, which are superficial to them.

(C), the *insertions* of the *musculus accessorius* into the angles of the six upper ribs, 3 to 3. These are superficial, like the insertions of the principal muscle; they, in fact, continue the insertions of the principal muscle without any apparent interruption, and somewhat conceal the following.

(D) (quite deeply, at the upper part), three of the relatively slender *tendons of origin* of the *cervicalis ascendens*, 4 to 4. These are related to the insertions of the musculus accessorius, just as are the *origins* of this latter muscle to the *insertions* of the ilio-costalis.

(E), the *insertions* of the *cervicalis ascendens* are shown a little higher up into the posterior tubercles of the three lower transverse processes.

LONGISSIMUS DORSI — Is the inner & larger division of the erector spinæ. Has two series of insertions in both the lumbar & the dorsal regions :

OUTER SERIES OF INSERTIONS – Posterior surfaces of transverse processes of the lumbar vertebræ, & nine or ten lower ribs internally to their angles.

INNER SERIES OF INSERTIONS – Lower and outer part of mammillary tubercles on back of superior articular processes of the lumbar vertebræ, & tips of the transverse processes of all the dorsal vertebræ.

Spinalis Dorsi – Spinous processes of the first two lumbar and last two dorsal vertebræ.

Spinous process of from four to eight of the middle & upper dorsal vertebræ. – Is intimately connected with the longissimus dorsi, of which it may be considered as an innermost portion ; the longissimus dorsi then having three series of insertions, middle, outer & inner (Cruveilhier).

Transversalis Colli – (*See* Figs. 486, 487) – Tips of transverse processes of the four or five upper dorsal vertebræ.

Posterior tubercles of transverse processes of the five lower cervical vertebræ.

Trachelo-Mastoid – (*See* Fig. 489) – Transverse process of the five upper dorsal vertebræ, and articular processes of the three or four lower cervical.

Posterior border of mastoid process beneath sterno-mastoid & splenius.

All the above muscles are supplied by the external branches of the posterior divisions of the cervical, dorsal & lumbar nerves.

COMPLEXUS – (*See* Fig. 490) – Transverse processes of the four or five upper dorsal and last cervical vertebræ ; articular processes of the three or four cervical vertebræ above.

Innermost rough depression between the two curved lines of the occipital bone. – Has a tendinous intersection a little above its middle.

Biventer Cervicis – (*See* Fig. 489) – Is but the inner part of the preceding muscle. – Transverse processes of the two or three upper dorsal vertebræ. The muscle has often an additional origin from the spinous processes of the last cervical and first dorsal vertebræ.

Occipital bone on inner side of preceding.

Spinalis Colli. – *See* page 275.

The complexus and biventer cervicis are supplied by the suboccipital and great occipital nerves, and by the internal branches of the posterior divisions of the cervical nerves.

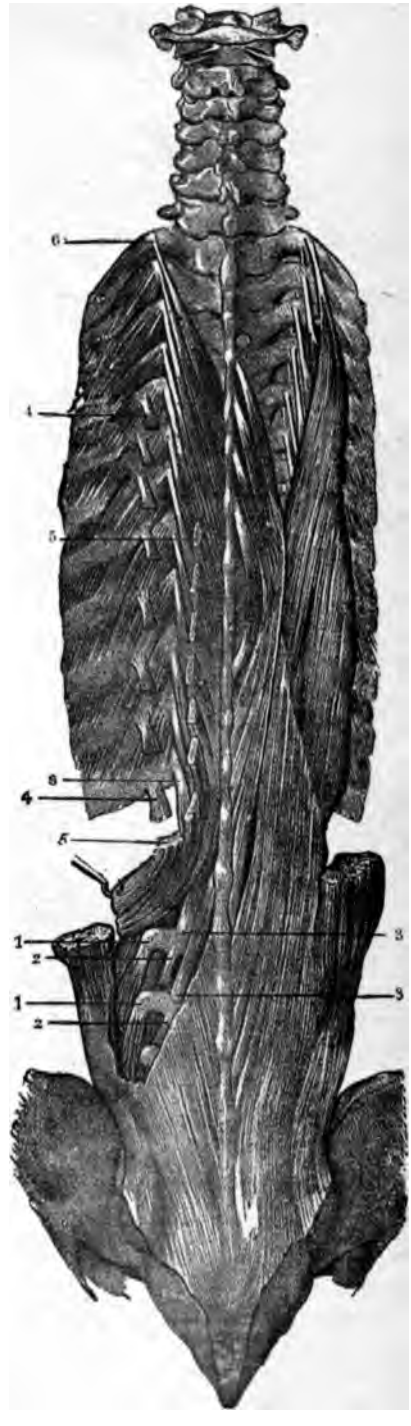


FIG. 484.—THE LONGISSIMUS AND SPINALIS DORSI MUSCLES. (Bourgery.)

The ilio-costalis has been cut away on both sides a little above the common origin of the erector spinæ.

The figure shows :—

A. In the LEFT LUMBAR REGION :

EXTERNALLY, both the *outer* and *inner* lumbar *insertions* of the longissimus dorsi into, respectively, the apices of the transverse processes, 1, 1, and into the lower and outer part of the mammillary tubercles on the back of the superior articular processes, 2, 2 ;

INTERNALLY, the lumbar *origins* of the multifidus spinæ from the upper and inner part of the above-mentioned mammillary tubercles, 3, 3.

B. In the THORACIC REGION :

[*a*], ON THE LEFT SIDE :

Externally, the *outer* thoracic *insertions* of the longissimus dorsi (nine lower ribs internally to their angles), 4 to 4, the tendons being cut off from the corresponding fleshy portions, which have been partly removed ;

Quite internally, the said corresponding fleshy portions, which have been partly removed, 5 to 5, to show,

Between the two, the *inner* thoracic insertions (tips of the transverse processes of all the dorsal vertebræ), 6 to 6.

[*b*], ON THE RIGHT SIDE :

Externally, the above inner thoracic insertions drawn outwards (the lower tendons being thus concealed), to show,

Internally, the origins and insertions of the *spinalis dorsi*.

EXPLANATION OF FIGURE 485.

The figure presents :-

A. - IN THE LUMBAR AND SACRAL REGIONS - A superficial view of the undisturbed Erector Spinæ, 1.

B. - IN THE THORACIC REGION on the *right side* - A view of the undisturbed Ilio-costalis, 2, and Longissimus Dorsi, 3, - the two muscles being separated by a narrow cellular interval, - and of their undisturbed continuation-muscles, the Musculus Accessorius and Ilio-costalem, 4, Cervicalis Ascendens, 5, Transversalis Colli, 6; and Trachelo-mastoid, 7.

C. - IN THE THORACIC REGION on the *left side*. - A view of the foregoing muscles separated and turned aside, - the Ilio-costalis being turned outwards, and the Longissimus Dorsi inwards.

The turning outwards of the Ilio-costalis conceals the costal insertions both of the muscle itself (except the one or two lower ones, 8, 8, which are just visible), and of the musculus accessorius at ilio-costalem (except the one or two upper ones, 9, 9, which may just be perceived quite at the upper part of the thorax). The displacement brings into view the *origins* of the Musculus Accessorius at Ilio-costalem, 10 to 10, and those of the Cervicalis Ascendens, 11 to 11.

The turning inwards of the Longissimus Dorsi exposes : -

(*a*) INFERIORLY, its *external thoracic insertions* (into the nine lower ribs internally to their angles), 12 to 12.

(*b*) HIGHER UP, the upper part of its *outer thoracic insertions* (into the tips of the transverse processes, 13 to 13), - the lower inner thoracic insertions being concealed by the outer thoracic insertions. The tendons forming the inner thoracic insertions are seen to be longer and more slender than those forming the outer thoracic insertions.

(*c*) QUITE AT THE UPPER PART, the continuation muscles, the Transversalis Colli, 14, and Trachelo-mastoid, 15.

Quite at the upper part of the figure, on either side of the middle line, there are seen the Complexus muscle, 16, with the Biventer Cervicis, 17. Between this and the trachelo-mastoid there is seen the transverse process of the atlas, with portions of the superior and inferior oblique muscles.

—GENERAL VIEW OF THE ILIO-COSTALIS, THE LONGISSIMUS DORSI, AND THEIR ACCESSORY MUSCLES. (Bourgery and Jacob.

Fig. 486.—THE TRANSVERSALIS COLLI. (Cloquet.)

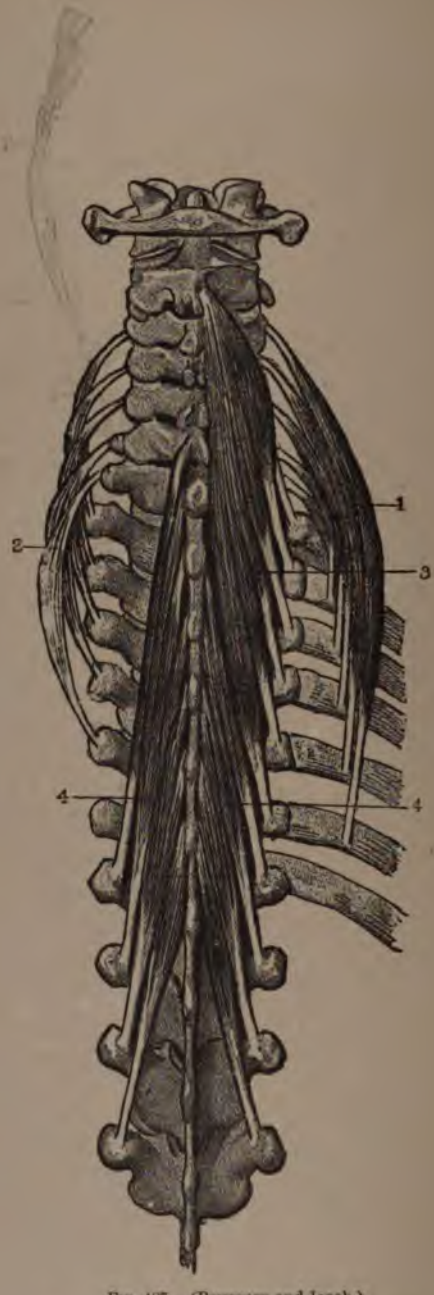


Fig. 487. (Bourgery and Jacob.)

1, cervicalis ascendens; 2, transversalis colli; 3 & 4, semispinales dorsi and colli.

Fig. 488*i*. (Bourgery and Jacob.)

1, solenius; 2, trachelo-mastoid; 3, complexus & biventer cervicis.

Fig. 489. (Bourgery and Jacob.)

1, complexus; 2, biventer cervicis; 3, trachelo-mastoid.

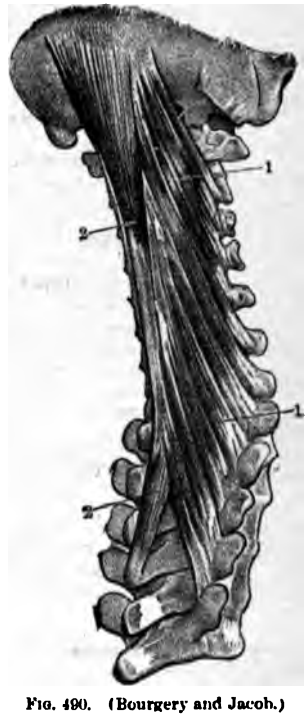


Fig. 490. (Bourgery and Jacob.)

1, 1, complexus; 2, 2, biventer cervicis.

EXPLANATION OF FIGURES 491 & 492.

Figure 491 shows the Multifidus Spinæ undisturbed on the right side close to the spine. Just externally to it is the series, also undisturbed, of the levatores costarum muscles.

On the left side the greater part of the multifidus spinæ has been removed, its attachments only being left. In the key-plan (Fig. 492), a small *o* marks the series of the origins from the sacral groove, and from the upper and inner part of the lumbar mammillary processes, the thoracic transverse processes, and the cervical articular processes. The series of insertions into the spinous processes and the laminæ is marked in the key-plan with a cross.

The dorsal series of attachments of the ilio-costalis and its accessory scles to the angles of the ribs is seen to consist of twenty-four small tendons. The six lower external tendons – (enclosed in the key-plan in a ring marked 1) – are the tendons of *insertion* of the ilio-costalis. The six lower internal, and the six upper external tendons – (enclosed in the key-plan in a ring marked 2) – are the tendons of *origin* and *insertion*, respectively, of the musculus accessorius at ilio-costalem. The six upper internal tendons – (enclosed in the key-plan in a ring marked 3) – are the tendons of *origin* of the cervicalis ascendens.

A little internally to the above are seen the *outer* series of the *thoracic insertions* of the longissimus dorsi into the eight or nine lower ribs internally to their angles. This series of insertions is enclosed in the key-plan in a ring marked 4, which ring is prolonged downwards into the lumbar region, where it includes the *outer lumbar insertions* of the muscle into the apices of the lumbar transverse processes.

More internally still, and running along the whole length of the lumbar and thoracic portions of the spine, is the series of the *inner insertions* of the longissimus dorsi into the lumbar mammillary tubercles and into the apices of the transverse processes of the thoracic vertebræ, – this series being enclosed, in the key-figure, in a ring marked 5.

The left side of the cervical portion of the figure, and of the upper part of the thoracic portion require special attention. Quite externally, in the cervical region, there are seen some small forked tendons hanging down from the transverse processes: these are the insertions of the cervicalis ascendens, externally, and of the transversalis colli, internally. Just internally to these, in the cervical region and the upper part of the thoracic region, there are seen a series of small ascending tendons cut short, single in the cervical region, but double in the upper part of the thoracic region. In the key-plan these are enclosed in a ring marked 6. Of the double series of ascending tendons in the upper part of the thoracic region, the outer ones are the origins of the transversalis colli, and the inner ones those of the trachelo-mastoid. The cervical origins of these muscles are more or less conjoined.

Close to the middle line in the cervical region there are seen the double row of the interspinales muscles.

Quite close to the cervical, thoracic, and upper lumbar portions of the spine, on the left side, are seen the small tendons, ascending in the lower part of the figure, descending in th upper part, of the spinales dorsi and colli.

In the lumbar region, between the transverse processes, there are seen on either side, the posterior intertransversales muscles. On the left side there is shown the posterior portion of the quadratus lumborum muscle.

Connected with the two upper cervical vertebræ and the cranium, there are shown the recti capitis postici major and minor, and the superior and inferior oblique muscles (better seen in Fig. 493).

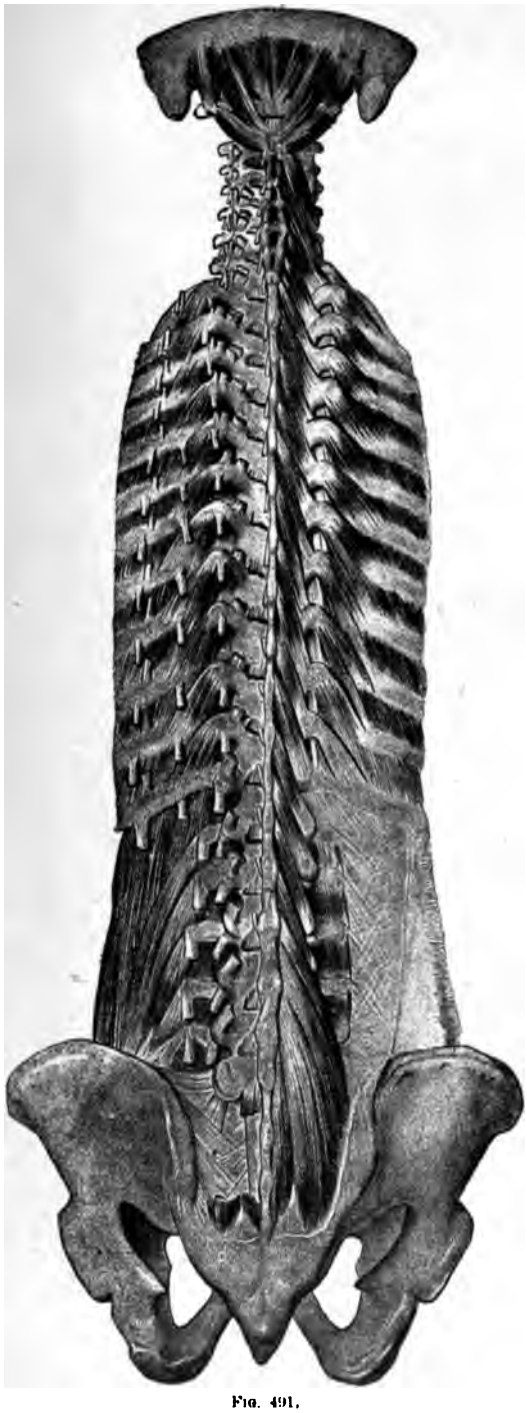


Fig. 491.

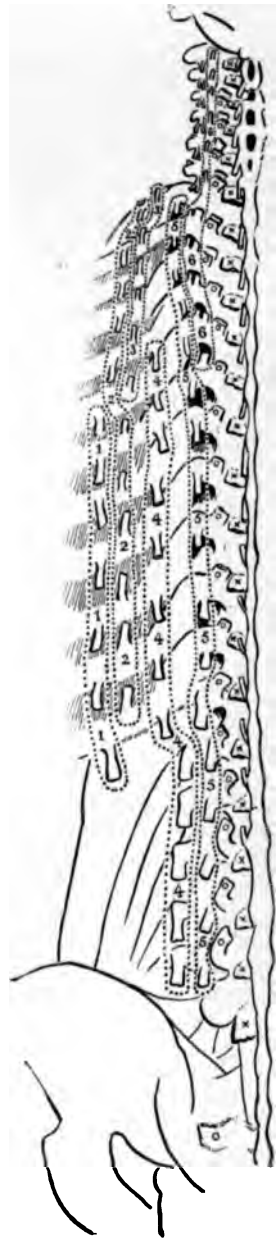


Fig. 492.

(*Key-plan.*)

THE MULTIFIDUS SPINÆ, WITH THE COMPLETE SERIAL ATTACHMENTS OF THE MUSCLES OF THE FOURTH AND FIFTH LAYERS. (Bourgery & Jacob.)

FIG. 493.—THE SMALL POSTERIOR CRANIO-VERTEBRAL MUSCLES. (Sappey.)

1, 2, recti capitis postici major and minor; 3, 4, inferior and superior oblique. The first and last are partly cut away.

FIG. 494.—THE SMALL POSTERIOR CRANIO-VERTEBRAL MUSCLES. SIDE VIEW. (Bourgery & Jacob.)

1, 2, recti cappostici major & minor; 3, 4, inferior & superior oblique; 5 to 5 interspinales muscles.

FIG. 495.—INTERSPINALES & INTERTRANSVERSAL MUSCLES. (Bourgery & Jacob.)

ONG EXTENSOR MUSCLES of the BACK — 5th Layer.

MULTIFIDUS SPINÆ - (*See* Figs. 491 & 492) — Is the innermost and deepest portion of the musculo-tendinous mass of the long extensor muscles of the back.

It lies in the vertebral groove beneath the erector spinæ and the longissimus dorsi, and extends along the whole length of the spine connecting the lateral to the postero-median processes of the vertebræ from the sacrum to the axis.

It is reinforced in the upper dorsal & cervical regions by the semispinales dorsi & colli, which may fairly be considered as its accessory fibres.

Its origins are homologous in the several regions of spine; they are as follows:

Sacral Region - Sacral groove and deep surface of tendon of erector spinæ; posterior superior spine of ilium & posterior sacro-iliac ligament.

Lumbar Region - Upper and inner part of the mammillary tubercles on back of superior articular processes.

Dorsal Region - Back of transverse processes.

Cervical Region - Articular processes of the four lower cervical vertebræ.

Its insertions are into the whole series of the spinous processes and the adjoining portion of the laminæ; the length of the individual fasciculi varying, some joining contiguous vertebra, others passing up to the 2nd, 3rd, or 4th vertebra above.

Semispinales Muscles - (*See* Fig. 487) — Are additional slips superadded to the preceding, on the surface of which they lie.

SEMISPINALIS DORSI - Transverse processes of the middle dorsal vertebræ from the 10th to the 5th.
Spinous processes of the four upper dorsal & two last cervical vertebræ.

SEMISPINALIS COLLI - Transverse processes of the four upper dorsal vertebræ.
Spinous processes of the cervical vertebræ from the axis to the 5th.

Rotatores Spinæ - Eleven pairs; lie in the dorsal region beneath the multifidus spinæ, of which they form the deepest fibres. - Upper & back part of transverse processes.
Lower margin & posterior surface of laminæ, and roots of spinous processes.

Spinalis Colli - (*See* Fig. 491) — Similar to spinalis dorsi, and as intimately connected with the complexus as is the latter with the longissimus dorsi. - Spinous processes of the one or two last cervical & the one or two upper dorsal vertebræ.
Spinous processes of the axis and of one or two vertebræ below. -- Is often wanting.

All the above muscles are supplied by the internal branches of the posterior divisions of the cervical, dorsal, & lumbar nerves; the complexus is also supplied by the suboccipital & great occipital nerves.

SHORT POSTERIOR CRANIO-VERTEBRAL MUSCLES.

Rectus Capitis Posticus Major – Spinous process of axis.
Into and beneath outer part of inferior curved line of occipital bone.

Rectus Capitis Posticus Minor – Tubercle on posterior arch of atlas.
Into and beneath inner part of inferior curved line of occipital bone.

Obliquus Capitis Inferior – Spinous process of axis.
Extremity of transverse process of atlas.

Obliquus Capitis Superior – Extremity of transverse process of atlas.
Occipital bone between the two curved lines externally to the complexus & rectus capitis posticus major.

These muscles are supplied by the posterior branch of the suboccipital nerve; the inferior oblique is also supplied by the great occipital nerve.

SMALL MS. of SPINOUS & TRANSVERSE PROCESSES.

Supraspinales – Small fleshy fasciculi which lie on the cervical spinous processes.

Interspinales – Short fleshy fasciculi placed in pairs between the spinous processes of the adjoining vertebræ. – There are six pretty distinct pairs corresponding to the six lower cervical vertebræ; four pairs corresponding to the lumbar vertebræ sometimes two or three rather indistinct pairs corresponding to the upper and lower dorsal vertebræ.

Intransversales – Short fleshy fasciculi which lie between the transverse processes of the adjoining vertebræ. – Are most developed in the cervical region, where they form seven pairs; they are tendinous in the upper part of the dorsal region muscular, but single in lumbar region & in lower part of dorsal.

These muscles are supplied, the two former by the internal, the latter by the external branches of the posterior divisions of the cervical dorsal & lumbar nerves.

THE NERVE CENTRES & THEIR COVERINGS.

PREFATORY NOTICE TO THE NERVE CENTRES.

The anatomy of the nerve-centres has been largely re-written: and the subject has been dealt with from both the dissectional and the "scientific" standpoints.

In no part of the body have recent discoveries been more numerous than in connection with the nerve-centres. It is believed that these will be found fairly recorded in the Tablets and Notes. Here, as elsewhere, the Tablets, – representing the *dissectional aspect* of Anatomy. – have been but slightly altered: *Dissectional Anatomy does not change.* They have been very amply "qualified or corrected" (?) from the interpretational point of view by means of the Notes.

It is submitted that in no part of the body has the divergence been more marked between plain naked-eye or dissectional Anatomy, on the one hand, and advanced, or "scientific," Anatomy, the Anatomy of the specialist, on the other; and that, as a consequence, there is no part of the body about which, in a practical sense, men know so little. Here, especially, strange as it may seem, microscopical structure and Anatomy viewed in the light of embryology and morphology, do *not* tally, in many notable instances, with outward configuration: Thus (1) the restiform bodies are to all outward appearances the continuation of the posterior columns of the cord; in reality – *i.e.*, *to the microscope* – they are not so. (2) To the naked eye the fourth ventricle is widely open superiorly (The term "open part" of the medulla is accepted by the most advanced anatomists); as a matter of fact – *i.e.*, *embryologice* – the fourth ventricle is as completely closed in as the third ventricle. (3) The roof of the third ventricle is apparently formed by the under surfaces of the velum interpositum and fornix; in reality – *i.e.*, *embryologice* – these structures have nothing to do with such roof. (4) The pia mater seems to penetrate, – indeed, is *seen* to penetrate, – into the interior of the brain through the transverse fissure; in reality – *i.e.*, *embryologice* – it does nothing of the kind; &c., &c.*

What has seemed to the Author the easiest way out of the difficulty in regard to these discrepancies, has been to describe certain things twice over, – first from the point of view of naked-eye or dissectional Anatomy, and then from the advanced or scientific standpoint. The reader will see where, and why, contradictory statements and conflicting opinions have been submitted, and where, and why, terms have been used, and have had to be used, in apparently antagonistic senses.

* These several divergencies remind one of the descendens hypoglossi being "in reality" a branch of the cervical plexus, of the "true" external jugular vein beginning at the mastoid foramen, of the "true" aortic arch as quite a different thing from the arch of either the pathologist or the physician, &c., &c., and almost force upon one Pilate's question, *What is truth?* In an observational science, truth means, to the Author's mind, *conformity to what one learns through one's senses.* But then, in the various connections above referred to, and in many others, "truth," – truth judged by the above standard, – is to some – to the new School – most unpardonable error, while it is the condemned – or courteously ignored – "error" that is undoubtedly the truth to others, – to the School of Gray, Ellis, Heath, Holden, ... and the Author.

It is believed that, if not in connection with the abdomen, it is in connection with the nerve-centres that the split must occur between dissectional and "scientific" Anatomy, which the Author has endeavoured to prepare for.

NOTE.

The Brain and correlated subjects now cover no less than a hundred and sixteen pages, seventy-two pages of Tablets, and forty-four of Notes. But, necessary repetitions set aside, the general difference in importance will be borne in mind between the subjects treated of in the Notes, and those treated of in the Tablets. Looking at the Notes, the most weighty matter presented is certainly that referring to the descriptions of the Cerebral Surface as given of late by Professors Cunningham and Turner, see pp. 348i to 348p. Careful attention should also be paid to the transverse section of the medulla through the middle of the olivary body, see page 348ii. It has been somewhat of a sacrifice to place these interesting topics among the Notes, but this seemed unavoidable.

In regard to the cerebral surface, two, one might say three, different lines of description have been followed. In the Tablets proper the subject is dealt with from the applied or utilitarian standpoint of the descriptions given in Gray's Anatomy. (Here it is the *interlobar fissures* and the *principal convolutions* that have been described.) Such descriptions ought, the Author thinks, to meet the wants of most men. The Notes on the Newer Matter deal with the subject with additional detail, and summarise the very interesting views above referred to of Professors Cunningham and Turner. (The *somewhat less important fissures* and *convolutions* have here been described.) Wider generalisations – somewhat wild imaginings, it is submitted – have been allowed scope in the description of the Limbic lobe. What has become of Broca's really useful *anthropological* work!

THE SURFACE of the CEREBRUM.

The cerebral hemispheres present five lobes: the frontal, parietal, occipital & temporal, and the central lobe or Island of Reil, to which may be added, in "advanced" anatomy, the opercular lobe (Macalister), and the limbic or falciform lobe (Broca, Schwalbe) demarcated on physiological or morphological grounds. These lobes, the latter excepted, are seen most extensively on the upper or convex surface of the hemispheres.

UPPER OR CONVEX SURFACE OF THE HEMISPHERES : — Presents:

THREE INTERLOBAR FISSURES:

FISSURE OF ROLANDO - (R) — Begins a little behind the middle of the longitudinal fissure and passes downwards & forwards to near the posterior limb of the fissure of Sylvius, separating the frontal & parietal lobes.

EXTERNAL PARIETO-OCCIPITAL FISSURE - (P.O.) - Separates the parietal and occipital lobes above. - Is usually not more than half an inch in length, and is sometimes scarcely recognisable except by its being continuous with the internal parieto-occipital fissure on the inner surface of the hemisphere (P.O., Fig. 500).

POSTERIOR LIMB OF THE FISSURE OF SYLVIUS - (S^1) - Passes backwards behind the central lobe, separting the temporal lobe from the frontal & parietal lobes. It ends by turning up into the parietal lobe, where it is arched over by the supra-marginal convolution.

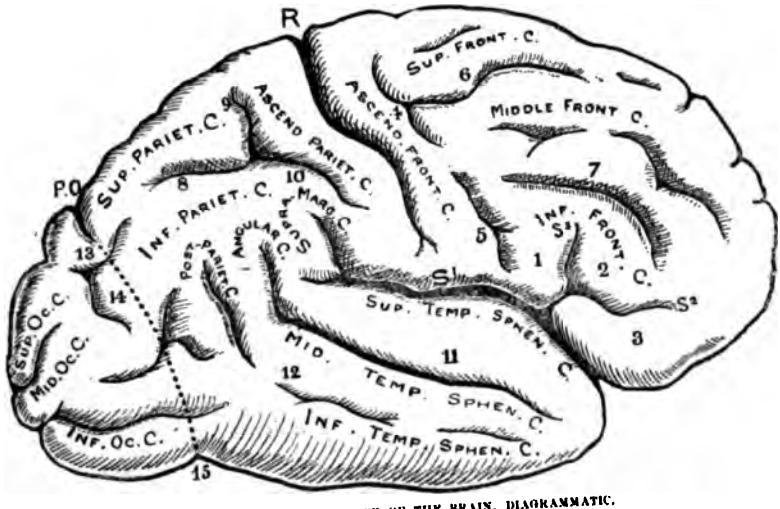


FIG. 496. — OUTER SURFACE OF THE BRAIN, DIAGRAMMATIC.

OUTER SURFACE OF THE FIVE LOBES:

FRONTAL LOBE - Presents:

Ascending Frontal Convolution - Forms the anterior boundary of the fissure of Rolando. Is usually continuous round the lower end of that fissure with the ascending parietal convolution. In front of this convolution is the

Precentral Sulcus (4 & 5) - Running parallel to the fissure of Rolando, and from which there pass forwards the

Superior & Inferior Frontal Sulci (6 & 7) - Separating the

Superior, Middle & Inferior Frontal Convolutions, - Which pass forwards one above the other to the anterior pole of the hemisphere.

PARIETAL LOBE - Presents:

Ascending Parietal Convolution - Forms the posterior boundary of the fissure of Rolando, and is usually continuous round the lower end of that fissure, with the ascending frontal convolution. - Behind this convolution are the superior & inferior parietal convolutions separated from the former and from each other by the three limbs of the intra-parietal fissure (8, 9, 10).

Superior Parietal Convolution - Extends along the side of the longitudinal fissure between the parieto-occipital fissure (P.O.), & the fissure of Rolando (R.); it is continuous in front with the upper part of the ascending parietal convolution, and joined behind to the superior occipital by the first annectent convolution.

Inferior Parietal Convolution - Divided according to still current descriptions (*V.* note, p. 348j) into:

Supra-marginal Convolution - Situated below and in front of the superior parietal convolution, and in front of the angular convolution. It is separated from the ascending parietal convolution by the lower limb of the intra-parietal, or post-central, fissure (10), and is connected behind with the angular convolution, and, below, with the superior temporal convolution round the posterior extremity of the fissure of Sylvius.

Angular Convolution - Situated behind the preceding. It blends below with the middle temporoal convolution, and is connected behind with the middle occipital by the second annectent convolution.

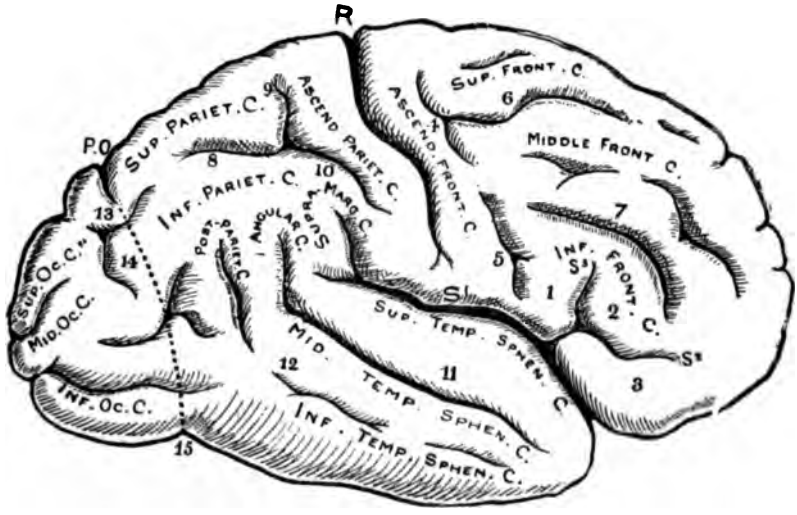


Fig. 497.—Outer surface of the brain, diagrammatic.

The **Inferior or Orbital Surface of the Frontal Lobe** will be best introduced here. It presents the *gyrus rectus*, or straight convolution, and the *three orbital convolutions, internal* (*I.*), *anterior* (*A.*), and *posterior* (*P.*), which latter are respectively continuous with the superior, middle, and inferior frontal convolutions of the outer surface. These convolutions are demarcated by the straight or olfactory, and the triradiate. sulci. The *straight or olfactary sulcus* (*olf.*) is parallel to the longitudinal fissure, and lodges the olfactory tract and bulb. The *triradiate sulcus* (*tr.*) usually presents three branches, running backwards, inwards, and outwards. It is sometimes H-shaped, another branch running forwards from the external branch. The gyrus rectus is sometimes described as forming part of the internal orbital convolution.

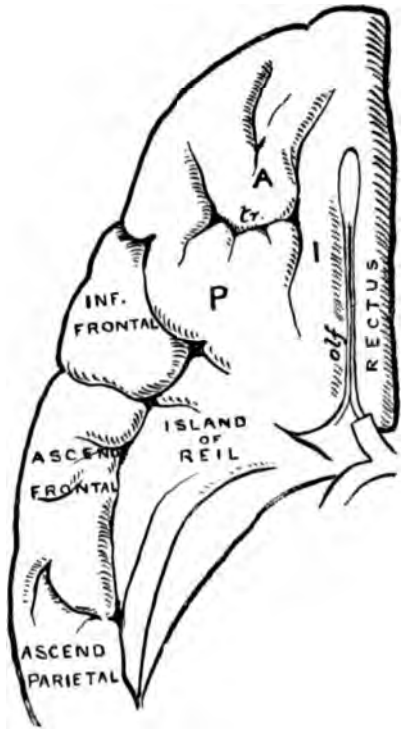


FIG. 498.—ORBITAL SURFACE OF THE FRONTAL LOBE, DIAGRAMMATIC.

TEMPORAL LOBE – Presents three well-marked antero-posterior convolutions, which are superposed to each other:

Sup. Temporal Convolution – Lies between the posterior limb of the fissure of Sylvius (S^1), and the parallel fissure (11), and is continuous behind with the supra-marginal & angular convolutions.

Middle Temporal Convolution – Is separated from the lower one by the inferior temporal fissure (12), and is continuous posteriorly with the angular and post-parietal convolutions, and connected by the third annectent with the middle occipital convolution.

Inf. Temporal Convolution – Is partly seen on the under surface of the cerebrum, where it is separated by the occipito-temporal fissure from the external occipito-temporal convolution. It is connected posteriorly to the third occipital by the fourth annectent convolution.

OCCIPITAL LOBE – Presents, according to still current descriptions (V. note, page 348), three rather badly defined convolutions, which are superposed to each other, and are more or less antero-posterior:

Sup. Occipital Convolution – Is connected to the superior parietal by the first annectent convolution.

Middle Occipital Convolution – Is connected to the angular & middle temporal convolutions by the second and third annectent convolutions.

Inf. Occipital Convolution – Is connected to the inferior temporal convolution by the fourth annectent convolution.

CENTRAL LOBE, or ISLAND OF REIL – Is deeply situated between the frontal & temporo-sphenoidal lobes at the bottom of the outer part of the fissure of Sylvius. It presents five or six convolutions, the *gyri operti*, which are nearly straight and mainly directed upwards and outwards, and of which the posterior ones are the largest.

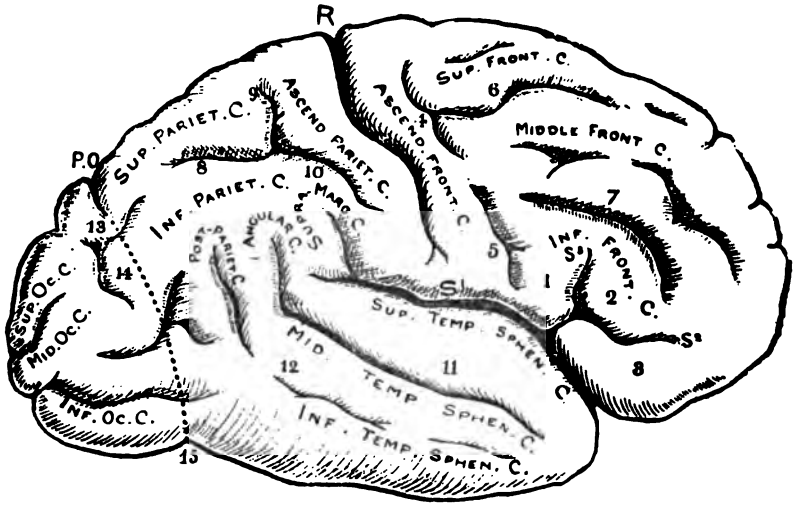


FIG. 429.—OUTER SURFACE OF THE BRAIN, DIAGRAMMATIC.

NNER SURFACE of the CEREBRUM

Presents for examination:

Marginal Convolution & Convolution of the Corpus Callosum, separated from each other by the *Calloso-marginal Fissure* (16);
Quadrate or Precuneate & Occipital or Cuneate Lobules, separated from each other by the *Internal Parieto-occipital Fissure* (*P.O.*), and of which the latter is separated by the *Calcarine Fissure* (17) from the internal occipito-temporal convolution;
Dentate Convolution (18), which is bounded below by the *Dentate or Hippocampal Fissure* (19).
Occipito-temporal Convolutions, two in number, internal & external, separated from the foregoing by the above-mentioned calcarine and dentate fissures, and from each other by the *Collateral Fissure* (20).

Marginal Convolution - Forms the lateral boundary of the anterior half of the longitudinal fissure. Beginning at the anterior perforated space, it first passes forwards as far as the apex of the frontal lobe, or anterior pole, and then curves upwards & backwards along the upper margin of the hemisphere to a little behind the fissure of Rolando (*R*).

Convolution of the Corpus Callosum, Callosal Gyrus, G. Fornicatus, or G. Cinguli - Begins anteriorly with the foregoing, and then winds backwards along the convex surface of the corpus callosum, from which it is separated by the so-called ventricle of the corpus callosum or callosal fissure. Posteriorly it joins above with the quadrate lobule, and then, becoming somewhat constricted (isthmus), it is reflected downwards & forwards round the splenium and continued into the hippocampal gyrus or gyrus uncinatus.

Calloso-marginal Fissure - (16) - First separates the two foregoing convolutions, and then ascends to the upper margin of the hemisphere a little behind the upper extremity of the fissure of Rolando (*R.*), separating the marginal convolution from the quadrate lobule.

Quadrate or Precuneate Lobule - Quadrilateral. Bounded above, in front, & behind respectively by the margin of the hemisphere, and by the calloso-marginal (16) & internal parieto-occipital fissures (*P. O.*).

Occipital or Cuneate Lobule - Triangular. Bounded behind, in front, & below respectively by the margin of the hemisphere and by the internal parieto-occipital fissure (*P.O.*) & the calcarine fissure (17).

Internal Parieto-occipital Fissure - (*P.O.*) - Separates the two foregoing lobules. It is continuous superiorly with the external parieto-occipital fissure; inferiorly it joins with the calcarine fissure (17).

Calcarine Fissure - (17) - Passes forwards from the apex of the occipital lobe to the isthmus of the gyrus fornicatus, and its point of junction with the gyrus uncinatus. It separates the occipital lobule from the internal occipito-temporal convolution, and joins anteriorly with the internal parieto-occipital fissure (*P.O.*). It corresponds in its anterior half to the hippocampus minor, or calcar avis, in the posterior cornu of the lateral ventricle.

Dentate Convolution (18) - Is a narrow serrated band of grey matter which lies beneath the corpus fimbriatum. It blends anteriorly with the uncus.

Dentate or Hippocampal Fissure - (19) - Separates the dentate convolution from the hippocampal gyrus or gyrus uncinatus, and corresponds to the hippocampus major.

Internal Occipito-temporal Convolution, Hippocampal Gyrus, or G. Uncinatus - Comprised between the dentate and calcarine fissures, above, and the collateral fissure (20), below, and extends along nearly the whole length of the temporo-sphenoidal lobe. It is constricted towards its middle (isthmus), where it is joined by the gyrus fornicatus, and enlarged in front & behind; anteriorly it presents a small hooked prolongation, the uncus, which curves upwards & backwards.

Collateral Fissure - (20) - Extends along nearly the whole length of the temporo-sphenoidal lobe, separating the hippocampal gyrus from the external occipito-temporal convolution. It corresponds towards its middle to the eminentia collateralis.

External Occipito-temporal Convolution - Is separated by the occipito-temporal fissure from the inferior temporal convolution of the outer surface of the hemisphere. This convolution, as well as the foregoing, might well be described as lying on the under or tentorial surface of the hemispher

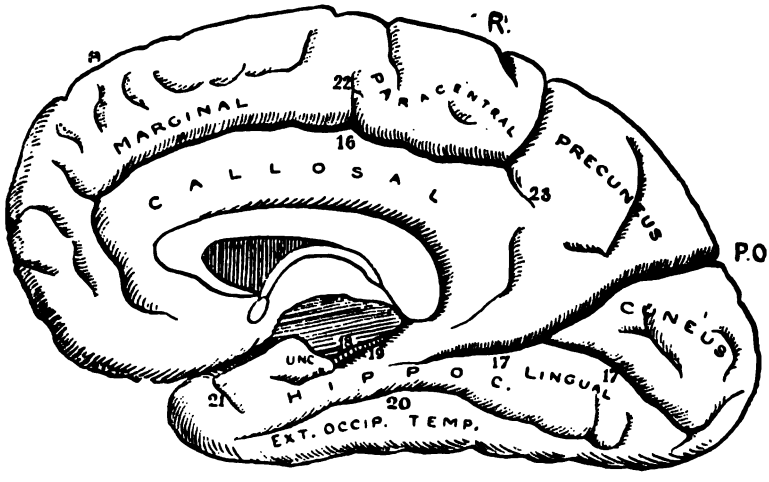


FIG 500.—INNER SURFACE OF BRAIN, DIAGRAMMATIC.

NDER SURFACE of the CEREBRUM

Presents from before backwards

IN THE MEDIAN LINE:

Anterior part of the Longitudinal Fissure – Bounded behind by the anterior extremity or genu of the corpus callosum.

Anterior Extremity or Genu of the Corpus Callosum – Curves downwards and backwards. Its narrowing reflected portion, beak or rostrum, is connected with the lamina cinerea, and gives off two white bundles, the peduncles (Fig. 505), which cross the anterior perforated space to the entrance of the fissure of Sylvius.

Lamina Cinerea – A thin layer of grey matter (Fig. 505) stretching, above the optic commissure, with which it is connected, from the rostrum of the corpus callosum to the tuber cinereum, and continuous laterally with the grey matter of the anterior perforated space. Forms part of anterior boundary of the third ventricle.

Optic Commissure or Chiasma with the **Optic Tracts** – *Vide* Optic Nerve, p. 228d.

Interpeduncular Space – Lozenge-shaped, comprised between the crura cerebri and the optic tracts and containing from before backwards:

Tuber Cinereum with the Infundibulum & Pituitary Body – The former of which is a conical eminence of the grey matter of the floor of the 3rd ventricle connected by a hollow infundibuliform process, the infundibulum, with the posterior lobe of the latter.

Corpora Albicantia – Two small round white bodies formed by the twisting upon themselves of the anterior crura of the fornix before they pass up to form the bundles of Vicq D'Azyr.

Posterior Perforated Space – Formed by a layer of grey matter, which constitutes the posterior part of the floor of the 3rd ventricle and is continuous round the corpora albicantia with the base of the tuber cinereum. It is perforated by numerous small foramina for the passage of the postero-median ganglionic branches of the posterior cerebral arteries going to the optic thalami and the walls of the 3rd ventricle.

Crura Cerebri – *Vide* Mesocephalon (p. 330).

LATERALLY:

Under Surface of the Frontal Lobe – Presenting internally the gyrus rectus, on the outer side of which are the olfactory sulcus containing the olfactory nerve and bulb, and, more externally, the triradiate sulcus and the three orbital convolutions.

Anterior Perforated Space – Formed by a layer of grey matter corresponding to the under surface of the corpus striatum, and perforated by numerous small foramina for the passage of the antero-lateral ganglionic branches of the middle cerebral arteries, which supply the caudate & lenticular nuclei, the internal capsule, and part of the optic thalamus. The space is bounded in front by the posterior and inner part of the frontal lobe and the roots of the olfactory nerve, and behind & to the inner side by the optic tract & commissure, and is continued externally into the

Vallecula Sylvii, or Stem of the Fissure of Sylvius – Which fissure separates the frontal and temporo-sphenoidal lobes, and divides on the outer surface of the hemisphere into its three limbs, anterior, ascending, and posterior.

Under Surface of the Temporal Lobe.

Behind these parts appear when the medulla oblongata & cerebellum are removed, in the median line:

Middle Part of the Transverse Fissure – Comprised between the corpora quadrigemina and the

Posterior Extremity of Splenium of the Corpus Callosum – Behind which is the

Posterior Part of the Longitudinal Fissure – And laterally the

Under Surface of the Occipital Lobe.

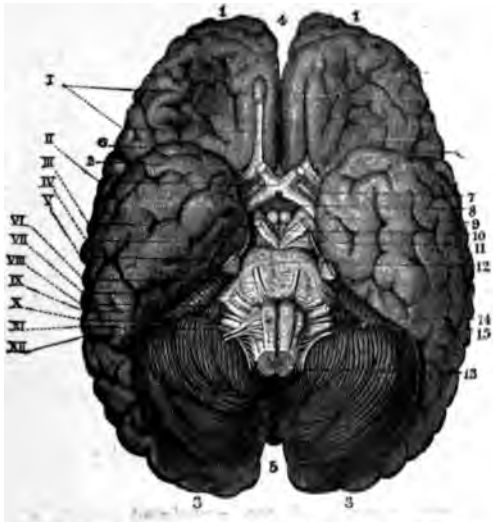


Fig. 501.—UNDER SURFACE OF THE CEREBRUM. (Sappey, Hirschfeld.) (*See* expl., p. 348uu).

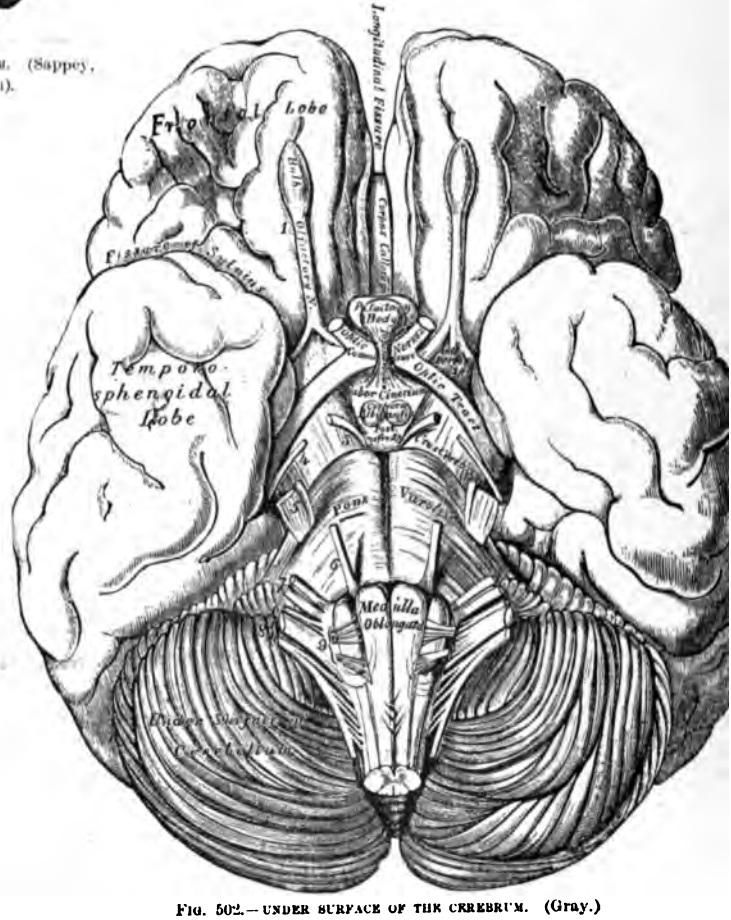


FIG. 502.—UNDER SURFACE OF THE CEREBRUM. (Gray.)

INTERNAL STRUCTURE of the HEMISPHERES.

PARTS SEEN BEFORE OPENING THE VENTRICLES:

Centrum Ovale Minus – With the puncta vasculosa & the convoluted margin of th divided grey matter

Callosal Fissure, or Ventricle of the Corpus Callosum – Comprised between th corpus callosum & the callosal gyrus. This fissure surrounds the corpus callosum, an becomes continuous at the splenium with the dentate fissure

Centrum Ovale Majus – Into which the main body of the fibres of the corpus callosun are continued on either side

Corpus Callosum – Thick stratum of transverse & radiating white fibres which connect th two hemispheres; situated above the fornix, to which it is joined behind, and to whic it is connected in front by the septum lucidum; forms the roof of both lateral ventricles arched from before backwards, thickest & broadest behind, thinnest towards centre It presents

UPPER SURFACE – Convex from before backwards, striated transversely, marked by median depressed raphé which is bounded by two slightly elevated bands termed th *striæ longitudinales*, or *nerves of Lancisi*. More externally, beneath the calloss gyrus, are other similar bands, the *striæ longitudinales laterales* or *striæ tectæ*.

UNDER SURFACE – Blended behind with the fornix. In front, where it forms the roof o the lateral ventricles, it is connected with the fornix by the septum lucidum

ANTERIOR EXTREMITY OR GENU – Curves downwards & backwards, presenting a narrowin reflected portion, the *beak or rostrum*. This latter is connected with the lamin cinerea, and gives off two small white bands or *peduncles* (Fig. 505), which cro the anterior perforated space to the entrance of the fissure of Sylvius.

POSTERIOR EXTREMITY OR SPLENIUM – Thick & rounded. Forms upper boundary middle portion of transverse fissure; is joined in front with the fornix.

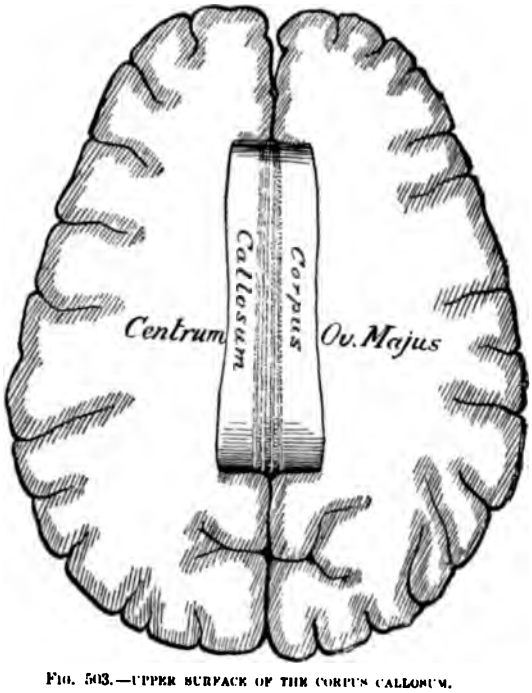


FIG. 503.—UPPER SURFACE OF THE CORPUS CALLOSUM.

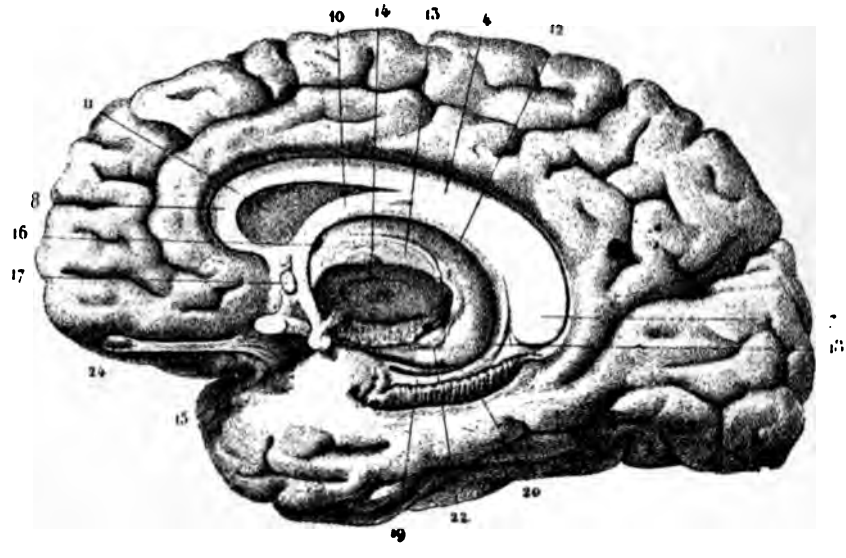


FIG. 504.—MESIAL SAGITTAL SECTION OF HEMISPHERES. (Hirschfeld.)

4, corpus callosum; 7, its posterior extremity or splenium; 8, its anterior extremity or genu continued downwards and backwards into the beak or rostrum; 10, fornix; 11, septum lucidum. (*See further expl., p.* 348nn.)

FIG. 505.—ANTERIOR EXTREMITY OF CORPUS CALLOSUM AS SEEN FROM BELOW. (Sappey.)

1, 1, frontal lobes drawn slightly apart; 2, genu of the corpus callosum continued into the beak or rostrum; 4, peduncles; 5, chiasma of the optic nerves turned backwards to show the lamina cinerea, 3; 6, olfactory nerve and bulb.

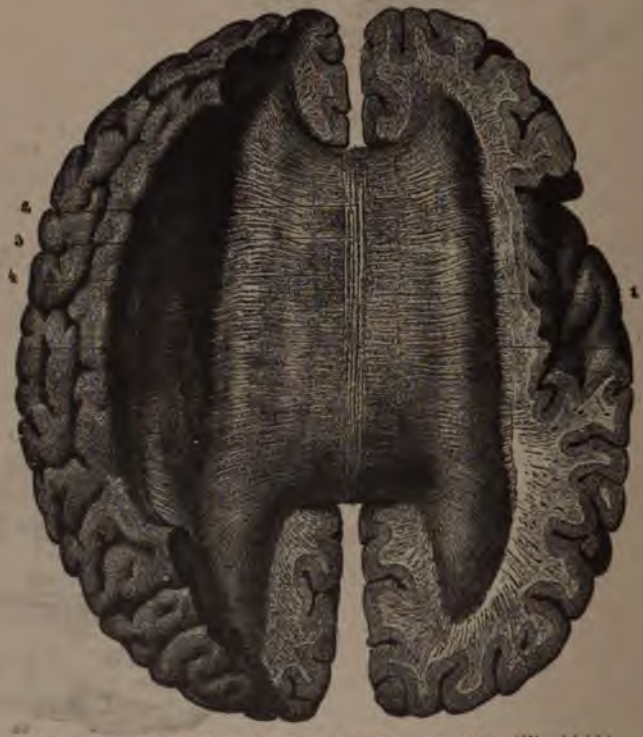


FIG. 506.—FIBRES OF CORPUS CALLOSUM AS SEEN FROM ABOVE. (Hirschfeld.)

The figure shows the forceps major, forceps minor, and tapetum. 2, 3, 4, median raphe, with striæ longitudinales & longitudinales laterales.

The fibres of the corpus callosum spread out into every part of the hemisphere.

The anterior fibres, those from the genu, first pass forwards into the frontal lobe, and then curve inwards, forming the *forceps minor*.

The posterior fibres, those from the splenium, pass backwards into the occipital lobe, and then turn inwards, forming the *forceps major*.

Of the central fibres, [1] The uppermost curve upwards and then inwards to the upper and mesial parts of the frontal & parietal lobes. [2] The intermediate pass outwards to the outer parts of the same lobes. [3] The lowest are divided into an anterior set, which go to the opercular convolutions, and a posterior set, which, forming the *tapetum*, spread out over the posterior & descending cornua of the lateral ventricle into the occipital and temporal lobes respectively.

The rotundity of the splenium results from the posterior part of the corpus callosum doubling up upon itself, so that a small portion is folded forwards under the larger part (*See* Fig. 545).

On leaving the splenium posteriorly, the *striæ longitudinales* spread out on the isthmus of the gyrus fornicatus and on the gyrus uncinatus to form the *substantia reticularis alba* or *alveus*. The *striæ longitudinales* are continuous anteriorly with the peduncles. (*See* Limbic Lobe, p. 348p.)

FIG. 507.—FIBRES OF THE CORPUS CALLOSUM AS SEEN FROM UNDERNEATH. (Hirschfeld.)

1, 2, median raphe continued, anteriorly, into the two laminæ of the septum lucidum; 3, right tapetum; 4, forceps minor; 5, forceps major. There is shown in 6 & 7 the decussation of the fibres of the corpus callosum with those of the internal capsule, the latter being exposed in 6 through the removal of the caudate nucleus, and in 8 through the removal of the lenticular nucleus. 9, section of the claustrum; 10, splenium of corpus callosum; 11, section of genu with, behind it, the section of the fifth ventricle.

THE LATERAL VENTRICLES

Consist of a central cavity or body, and three prolongations or cornua.

Central Cavity or Body – Presents:

ROOF – Formed by under surface of corpus callosum

INNER WALL – Formed by the septum lucidum.

The *septum lucidum* is a thin triangular lamina, narrow behind, and broad in front. Its narrow posterior prolongation passes backwards into the interval between the body of the fornix and the corpus callosum. Its broader anterior portion corresponds posteriorly to the anterior crura of the fornix, and is attached in front to the genu of the corpus callosum, and below to the rostrum.

The septum lucidum consists of two thin transparent laminæ lying close to each other, but separated in the greater part of their extent by a slit-like interval, the so-called 5th ventricle. The laminæ are the approximated and partly fused remnants of the hemisphere walls, and the so-called ventricle is a remnant of the space between the two hemispheres, unconnected, of course, with the proper ventricular cavities of the brain. Each lamina presents a rudimentary layer of grey matter towards the 5th ventricle, a middle layer of white fibres, and, towards the lateral ventricle, a layer of ependyma and epithelium.

FLOOR – Formed from before backwards by caudate nucleus of *corpus striatum*, *tænia semicircularis*, *optic thalamus*, *choroid plexus*, *corpus fimbriatum*, & *fornix*.

Anterior Cornu – Passes downwards & outwards round anterior extremity of corpus striatum.

Posterior Cornu – Curves backwards & outwards, and then backwards & inwards in substance of occipital lobe. On inner part of its floor is the hippocampus minor or calcar avis, a longitudinal eminence corresponding to the front part of the calcarine fissure, and internally to which is the bulb of the cornu formed by the projection of the forceps major.

Middle or Descending Cornu – Curves backwards, outwards & downwards round optic thalamus, and then forwards & inwards to near anterior extremity of the temporal lobe. Its floor presents the *hippocampus major*, *pes hippocampi*, *eminentia collateralis*, *corpus fimbriatum*, & *choroid plexus*. The *transverse fissure* may be added in dissectional, as opposed to interpretational, Anatomy.

FIG. 508.—MESIAL SECTION OF HEMISPHERES. (Hirschfeld.)

4, 7, 8, corpus callosum, with its posterior extremity or splenium, and its beak or rostrum; 11, septum lucidum; 10, fornix; 18, its posterior crus continued into the corpus fimbriatum or fimbria; 13, corpus albicans, into which the anterior crus of the fornix descends, passing in front of the foramen of Monro, 18, and behind the anterior commissure, 17. (*See further expl.*, p. 348uu.)

FIG. 509.—FLOOR OF LATERAL VENTRICLE. (Hirschfeld)

5, caudate nucleus; 6, 7, taenia semicircularis and lamina cornea; 4, optic thalamus; 8, choroid plexus; 1, fornix; 9, 10, 11, anterior, descending, and posterior cornua, the latter showing the hippocampus minor and the bulb of the cornu. (Hirschfeld.) (*See further expl.*, p. 299.)

PARTS SEEN on FLOOR of LATERAL VENTRICLE.

Are from before backwards

CORPUS STRIATUM (Caudate nucleus of) – *See* note, p. 302.

TÆNIA SEMICIRCULARIS – Whitish semi-transparent band of fibres, which descends anteriorly in connection with anterior crus of fornix, and posteriorly accompanies the tail of the caudate nucleus into the descending cornu of the lateral ventricle, to end with it in the amygdaloid nucleus. It is partly concealed by the vena corporis striati, and by a thickened band of ependyma, the lamina cornea.

OPTIC THALAMUS – Only the anterior and outer part of its upper surface, presenting the *anterior tubercle*. (The optic thalamus is described along with the 3rd ventricle, p. 314.)

CHOROID PLEXUS – The thick, convoluted & fringe-like margin of the velum interpositum. – *Vide* Velum Interpositum, p. 306.

CORPUS FIMBRIATUM, FIMBRIA, or TÆNIA HIPPOCAMPI – The thin lateral margin of the posterior crus of the fornix. The term is more particularly applied to the continuation of the same as prolonged into the descending cornu – *see* below.

FORNIX – Triangular longitudinal lamella of white fibres, broad behind, narrow in front, situated below corpus callosum, with which it is joined behind, and to which it is connected in front by septum lucidum ; forms roof of 3rd (*see* morphological view, p. 348u), and posterior part of floor of both lateral ventricles. Presents :

Body – Presents :

Upper Surface – Joined behind with corpus callosum, and connected in front to the same by septum lucidum ; forms posterior part of floor of both lateral ventricles.

Under Surface – Marked posteriorly by a few transverse fibres belonging to the corpus callosum, which, with the converging fibres of the fornix, form the *lyra*. Covered by velum interpositum, with which it forms centrally the roof of 3rd ventricle (*see* morphological view, p. 348u) ; rests laterally upon optic thalami.

Anterior Crura – Descend behind anterior white commissure and in front of optic thalamus, forming anterior boundary of foramina of Monro, and perforate grey substance of floor of 3rd ventricle to corpora albicantia, in which they twist upon themselves previous to ascending into the front part of the optic thalami under the name of bundles of Vicq d'Azyr.

Posterior Crura – Diverge into the descending cornua of lateral ventricles, becoming continuous with inner border of hippocampus major (*see* Figs. 513, 514). Their thin lateral margin is the *corpus fimbriatum* or *tænia hippocampi*.

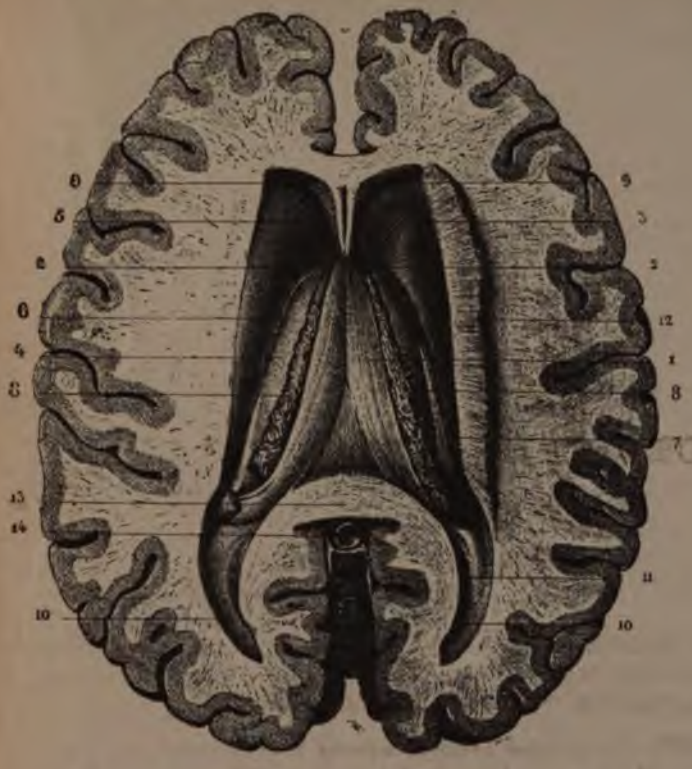


FIG. 510.—FLOOR OF LATERAL VENTRICLE
(Hirschfeld.)

5, caudate nucleus of corpus striatum ; 6 and
semicircularis and lamina cornea ; 4, optic th
8 ; choroid plexus emerging anteriorly from for
Monro, 2, and disappearing posteriorly into des
cornu : a portion of the left choroid plexus is r
to show the corpus fimbriatum as it leaves the
of the fornix ; 1, fornix ; 3, septum lucidum, d
9, 11, 10, anterior, descending, and posterior
the latter showing the hippocampus minor
bulb of the cornu ; 12, corpus callosum turn
wards ; 13, section of splenium : the section
genu is seen in front of the septum lucidu
common trunk of the venæ Galeni.

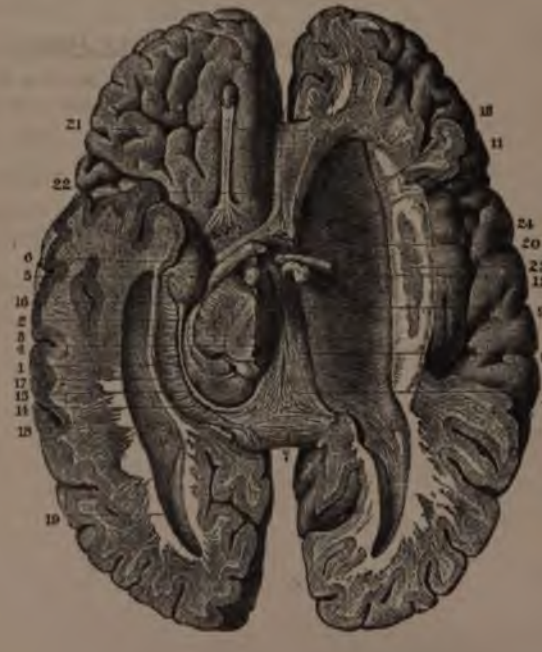


FIG. 511.—DEEP DISSECTION OF THE BRAIN FROM UNDERNEATH. (Hirschfeld.)

10, under surface of fornix, showing the lyra ; 11, anterior crura of fornix passing down to the corpora albicantia, 12 ; in front of these is the transverse commissure, 13 ; 7, splenium of corpus callosum with which the fornix is fused posteriorly ; 14, 15, posterior crura of fornix and corpus fimbriatum, the latter ending in the uncus of the gyrus uncinatus : externally to these is seen the dentate convolution ; 1, 2, corpora geniculata and optic tract. (*See further expl., p.* 348m.)

)()

'ARTS SEEN in DESCENDING CORNU of LATERAL VENTRICLE.

HIPPOCAMPUS MAJOR or CORNU AMMONIS - Is a white eminence which curves downwards, forwards, & inwards along floor of descending cornu of lateral ventricle, and which corresponds to the dentate fissure. It enlarges anteriorly, and ends in the

PES HIPPOCAMPI - The anterior rounded extremity of the hippocampus major; it more or less resembles the paw of an animal, being marked along its margin by slight notches or depressions separating rounded intervening elevations.

EMINENTIA COLLATERALIS - A small rounded eminence, situated between the two hippocampi at junction of posterior & middle cornua, and prolonged more or less on the floor of the latter externally to the hippocampus major. It varies considerably in size. It corresponds to the middle part of the collateral fissure.

FIMBRIA, or TÆNIA HIPPOCAMPI - The prolongation of the thin lateral margir of the posterior crus of the fornix; is continuous with inner border of hippocampus major; becomes lost in the uncus of the hippocampal convolution.

CHOROID PLEXUS - *See* p. 306.

TRANSVERSE FISSURE - *See* pp. 306 & 348u.

FIG. 512.—DESCENDING AND POSTERIOR CORNUA OF THE LATERAL VENTRICLE, SEEN FROM ABOVE. (Sappey, Hirschfeld.)

1, descending cornu; 2, 3, hippocampus major, with the pes hippocampi and corpus fimbriatum; 4, dentate convolution; 6, posterior cornu, showing the hippocampus minor and the bulb of the cornu; 7, 8, sections of posterior crus of fornix and of splenium; 5, uncus of hippocampal convolution.

FIG. 513.—LATERAL SAGITTAL SECTION, SHOWING SIDE VIEW OF THE BODY (5) AND THE THREE CORNUA OF THE LATERAL VENTRICLE. (Hirschfeld.)

All three parts are roofed in by the corpus callosum, whose divided fibres are seen in 11. 6, descending cornu, showing 7 and 8, the hippocampus major with the pes hippocampi and the corpus fimbriatum; 9, 10, posterior cornu with the hippocampus minor, and, above it, the bulb of the cornu. Between the cornua is the rounded eminentia collateralis. 1, 2, caudate and lenticular nuclei of the corpus striatum; 4, internal capsule; 12, transverse commissure.

Above the hippocampus major and the corpus fimbriatum is the section of the posterior extremity of optic thalamus; between the two is the lateral portion of the transverse fissure.

FIG. 514.—THE SAME, WITH CHOROID PLEXUS LYING IN THE LATERAL PART OF THE TRANSVERSE FISSURE. (Hirschfeld.)

CORPUS STRIATUM.

The *corpus striatum* is a large and complex mass of nervous substance consisting of the caudate and lenticular nuclei with the intervening, and enveloping, internal and external capsules.

CAUDATE NUCLEUS.

The *caudate nucleus* is the surface portion of the corpus striatum, and the only portion that can be made out, except by means of sections. It is a thin stratum of grey matter arched from before backwards and outwards, so as to present, in horizontal section, two portions placed at a distance from each other. It is thickest at its anterior end, or *head*, which bulges into the anterior cornu of the lateral ventricle. From thence it ascends with an inclination backwards and outwards into the body of that cavity, forming the anterior and outermost part of its floor. It then passes into a gradually narrowing *tail*, which descends first in the anterior wall, and then in the roof of the descending cornu, to end in the amygdaloid tubercle at the extreme end of the roof. The deep surface of the caudate nucleus is separated in the main from the lenticular nucleus by the inner capsule; quite in front, however, the head is directly continuous with the lenticular nucleus, and a little further back it is still connected with the same by bands of grey matter which here intersect the fibres of the internal capsule. (*See* Fig. 516.)

LENTICULAR NUCLEUS.

The *lenticular nucleus* comes to the surface at the anterior perforated space, where it is continuous both with the caudate nucleus and with the hereafter mentioned claustrum. It is otherwise separated by the external capsule from the claustrum, and by the internal capsule from the optic thalamus and the caudate nucleus.

In conjunction with the caudate nucleus, it must be studied in sections – horizontal sagittal, and coronal.

In horizontal section, the lenticular nucleus appears as a bi-convex lens with surfaces directed inwards and outwards, the inner surface being the more convex of the two. It has much the same shape in sagittal sections (Figs. 513, 514). In coronal sections far forwards, where it is closely connected with the caudate nucleus, it is crescentic, with convexity downwards and outwards (Fig. 516). In coronal sections further back, it becomes more and more disconnected from the caudate nucleus, and triangular; here it can be made out, in fresh brains, to consist of three zones of different structure, separated by thin medullary inter-sections. The two inner smaller zones are lighter in colour, and form the *globus pallidus*. The outer larger zone, or *putamen*, is darker in colour (Figs. 517, 518). This latter is the longest part of the lenticular nucleus from before backwards, and that which is continuous anteriorly with the caudate nucleus and the claustrum.

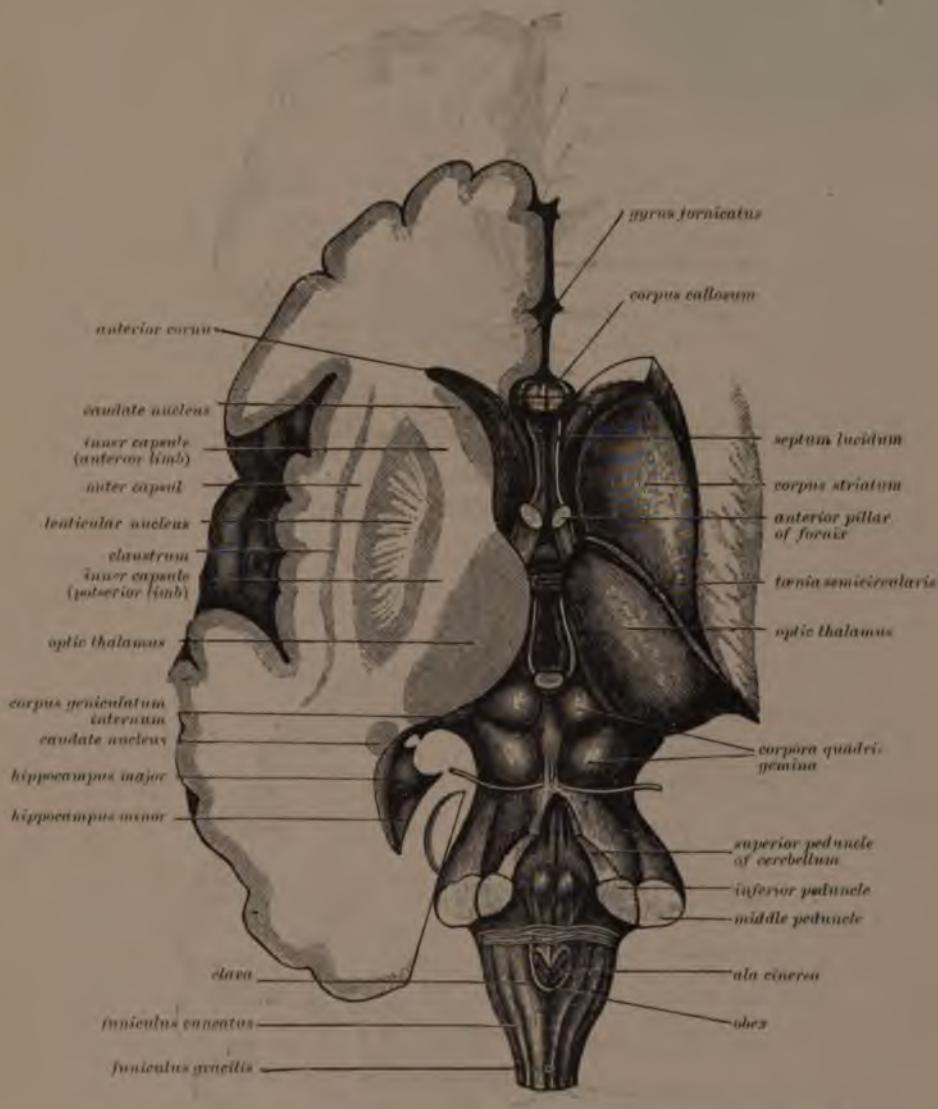
The caudate nucleus is of same structure throughout, and the only peculiarity it presents is, in horizontal sections, its division into the two parts above referred to. In the horizontal section just below the foramina of Monro (which best shows the caudate and lenticular nuclei, the inner & outer capsules, optic thalamus, and claustrum), the head and the tail of the caudate nucleus are separated by the whole length of the body of the lateral ventricle.

CLAUSTRUM.

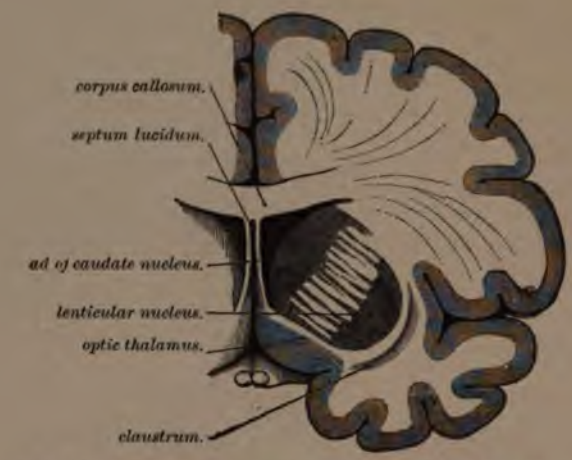
The *claustrum* is a thin stratum of grey matter stretched vertically on the outer side of the lenticular nucleus. It is connected anteriorly with the putamen, but is otherwise separated from the lenticular nucleus by the outer capsule. It lies just internal to the Island of Reil, from which it is separated by a layer of white matter, into which it sends pointed processes corresponding to the gyri operti.

EXTERNAL CAPSULE.

The *external capsule* is a narrow plane of white fibres separating the lenticular nucleus from the claustrum.



515.—HORIZONTAL SECTION JUST BELOW FORAMEN OF MONRO. (Morris, after Landois and Stirling.)



516.—CORONAL SECTION THROUGH CORPUS STRIATUM, OPPOSITE ANTERIOR HORN OF LATERAL VENTRICLE. (Gegenbaur.)

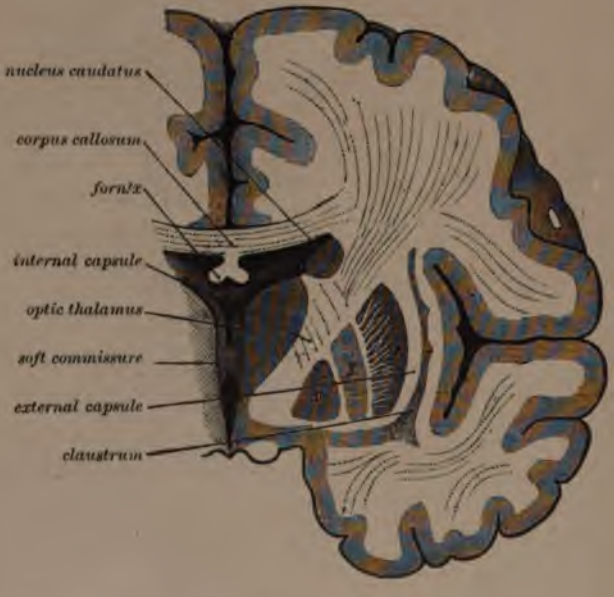


FIG. 517.—CORONAL SECTION THROUGH CORPUS STRIATUM A LITTLE IN FRONT OF MIDDLE OR SOFT COMMISSURE. (Gegenbaur.)

It is the posterior surface of the section that is shown. 1, putamen of lenticular nucleus; 2 & 3, globus pallidus. (*See also Fig.* 518.)

INTERNAL CAPSULE.

The *internal capsule* is a similar but much wider plane separating the lenticular nucleus from the caudate nucleus in front, and the optic thalamus behind. In coronal section it shows the arched arrangement of the white radiating bundles. In horizontal section, which shows best the main anatomical features, it presents a shorter anterior limb separating the lenticular and caudate nuclei, and a longer posterior limb separating the lenticular nucleus from the optic thalamus. The two limbs meet at angle open externally, the genu. The anterior limb contains the fibres passing from the frontal lobe to the inner part of the crus cerebri; the front part of the posterior limb, the part just behind the genu, contains the fibres passing from the motor area to the middle part of the crus; the back part of the posterior limb contains the fibres passing from the occipital and temporal lobes to the outer part of the crus.

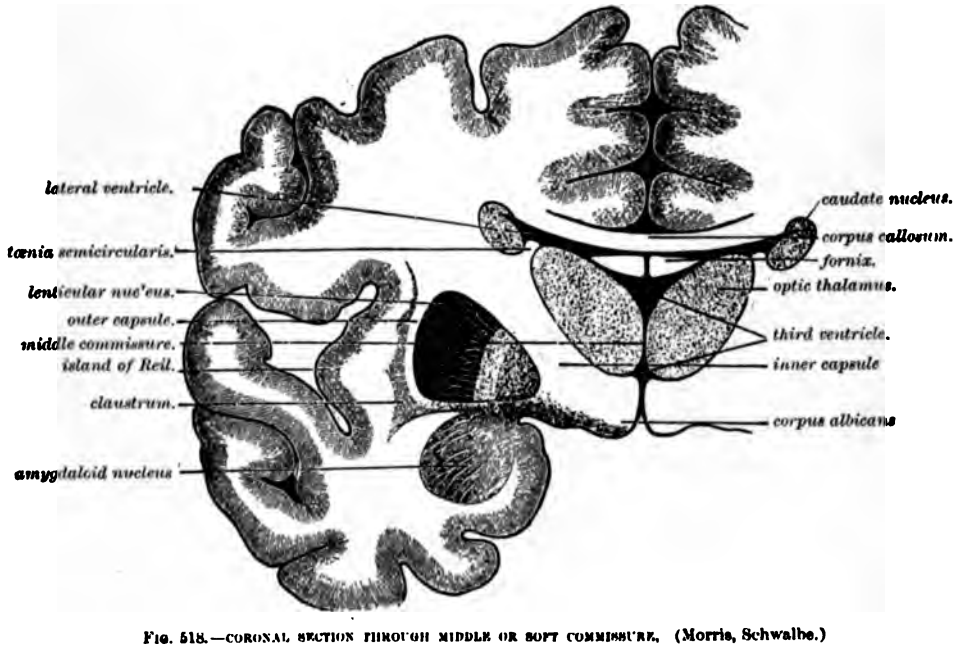


FIG. 518.—CORONAL SECTION THROUGH MIDDLE OR SOFT COMMISSURE. (Morris, Schwalbe.)

TRANSVERSE FISSURE of the BRAIN & INTRA-CEREBRAL PORTION of the PIA MATER.

TRANSVERSE FISSURE OF THE BRAIN *

Is of a horse-shoe shape, and about four inches wide.

Its central part is horizontal and comprised between the tubercula quadrigemina & the posterior extremity or splenium of the corpus callosum.

Its lateral portions curve downwards and forwards in the descending cornu of the lateral ventricle, and are comprised between the optic thalami and the hippocampi majores & corpora fimbriata. (*See* Figs. 513, 514.)

This fissure transmits the pia mater into the interior of the brain.

INTRA-CEREBRAL PORTION OF THE PIA MATER

Forms on the one hand the velum interpositum & the choroid plexuses of the lateral & the 3rd ventricles, and, on the other, the tela choroidea & the choroid plexuses of the 4th ventricle.

Velum Interpositum – Is a double fold of pia mater, triangular in shape, which is reflected into the interior of the brain through the transverse fissure. It presents:

CENTRAL PORTION – Invests the pineal gland, and covers the under surface of the fornix. From the under surface of this central portion two small vascular fringes, the choroid plexuses of the 3rd ventricle, hang down into the latter cavity.

LATERAL MARGINS – Spread out on either side beneath the corresponding margin of the fornix & its continuation, the corpus fimbriatum, into the body & descending cornu of the corresponding lateral ventricle, resting, as do the margins of the fornix, upon the optic thalami. These lateral margins are thick, convoluted & fringe-like; they constitute the choroid plexuses of the lateral ventricles further described below.

POSTERIOR MARGIN OR BASE – Turned backwards towards the transverse fissure. It is continuous with the general pia mater: it receives the anterior & posterior choroid arteries and emits the venæ Galeni.

ANTERIOR BIFID EXTREMITY – Continuous through the foramina of Monro with the anterior pointed extremities of the lateral margins above described or choroid plexuses of the lateral ventricles.

Choroid Plexuses of the Lateral Ventricles – Are nothing more than the thick, convoluted & fringe-like margins of the velum interpositum. When described separately, that is to say irrespectively of the velum interpositum of which they are a portion, they may be said to penetrate into the descending cornua of the lateral ventricle through the lateral portions of the transverse fissure (*see* Figs. 513, 514). Hence they ascend into the body of the lateral ventricle along the side of the corpus fimbriatum, winding round the posterior extremity of the optic thalamus. Then, continuing along the side of the fornix, they taper to a point, and, passing through the corresponding foramen of Monro, they join with each other and with the anterior bifurcated extremity of the central & thinner portion of the velum interpositum.

Choroid Plexuses of the 3rd Ventricle – Are two small vascular fringes which hang down from the under surface of the central portion of the velum interpositum into the cavity of the 3rd ventricle; they diverge slightly behind.

Tela Choroidea – *Vide* Fourth Ventricle, page 326.

Choroid Plexuses of the 4th Ventricle – Are two similar fringes which project into the 4th ventricle from the layer of pia mater (tela choroidea) which closes that ventricle inferiorly; they pass upwards and then outwards from near the apex of the calamus scriptorius over the outer margin of the restiform body, and into the lateral recess of the fourth ventricle.

* *See note in black type on page 308.*

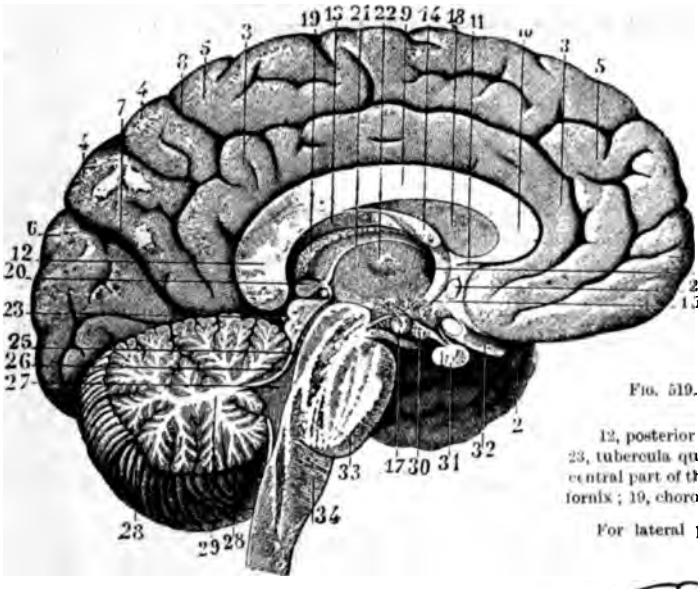


FIG. 519.—MESIAL SECTION OF ENTIRE BRAIN. (Sappey, Hirschfeld.)

12, posterior extremity or splenium of corpus callosum; 23, tubercula quadrigemina: between the two is seen the central part of the transverse fissure. 20, pineal gland; 13, fornix; 19, choroid plexus. (*See further expl., p.* 348vv.)

For lateral portions of the transverse fissure, *see* Figs. 513 and 514.

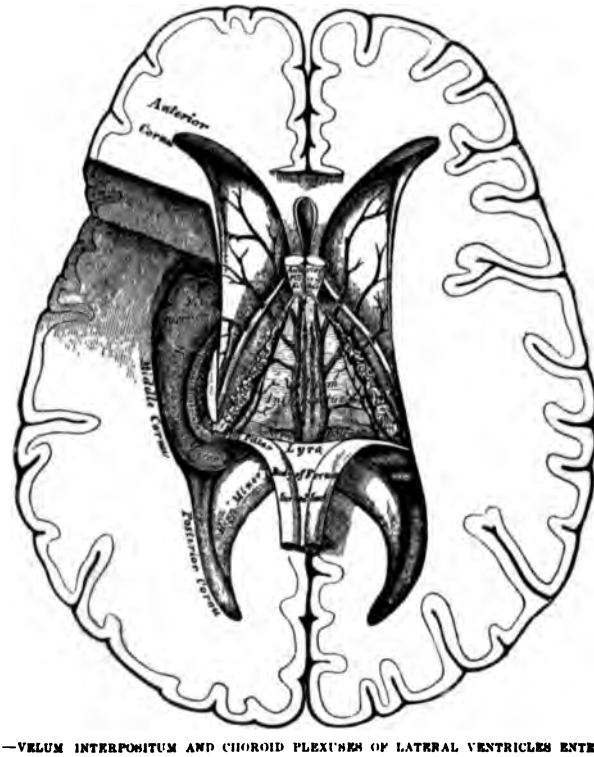


FIG. 520.—VELUM INTERPOSITUM AND CHOROID PLEXUSES OF LATERAL VENTRICLES ENTERING BRAIN THROUGH THE TRANSVERSE FISSURE. (Gray.)

There is no such thing as the transverse fissure, nor does the pia mater in any way penetrate into the interior of the brain. (*See* morphological view, p. 348u.)

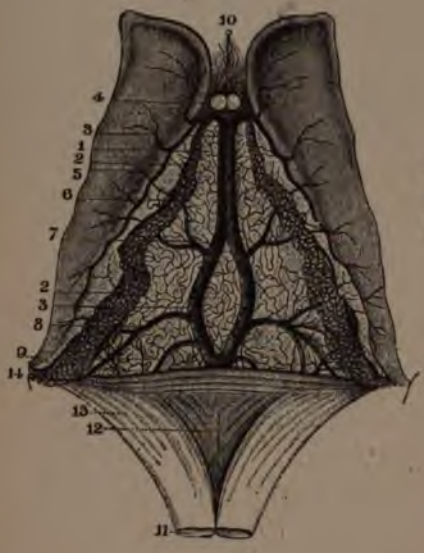


FIG. 521.—THE VELUM INTERPOSITUM AND CHOROID PLEXUSES. (Sappey.)

1, velum interpositum; 2, choroid plexuses of the lateral ventricle; 3, vena Galeni; 4, 5, 6, 7, 8, 9, venous twigs from corpus striatum, optic thalamus, descending and posterior cornua; 10, anterior crura of fornix, divided; 11, 12, 13, the fornix turned back, and showing its under surface with the lyra and the commencement of the posterior crura; 14, the choroid plexus and the posterior crura descending into the middle cornu of the lateral ventricle.

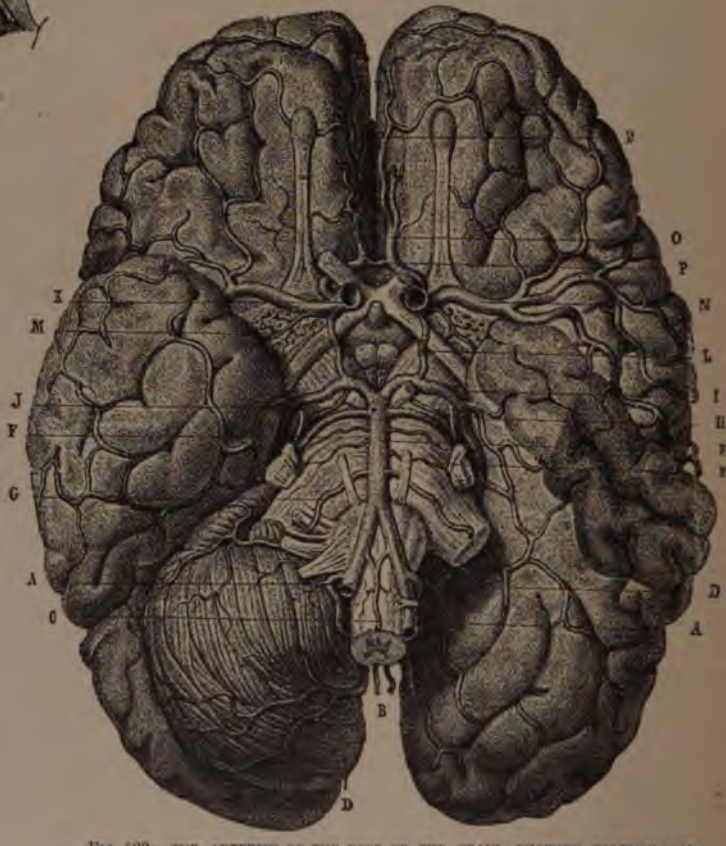


FIG. 522.—THE ARTERIES OF THE BASE OF THE BRAIN, SHOWING PARTICULARLY THE ANTERIOR AND POSTERIOR CHOROID ARTERIES, M, J, ON THE POINT OF ENTERING THE BRAIN THROUGH THE TRANSVERSE FISSURE. (Hirschfeld.) (*See further expl., p.* 340.

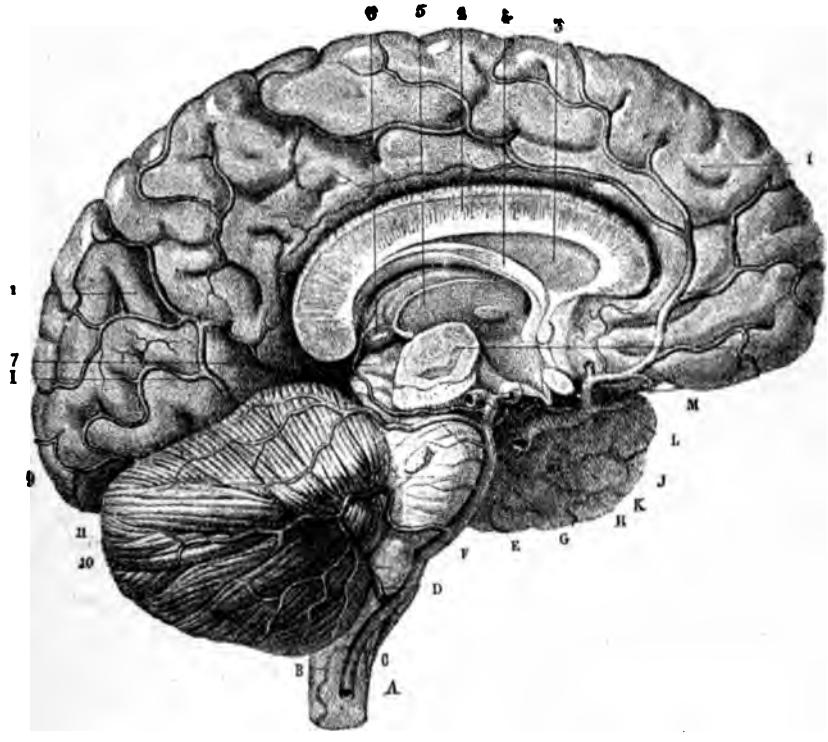


FIG. 523.—THE ARTERIES OF THE BASE OF THE BRAIN (SIDE VIEW), SHOWING PARTICULARLY THE POSTERIOR CHOROID, 1, ENTERING THE VENTRICULAR CAVITIES THROUGH THE TRANSVERSE FISSURE. (Hirschfeld.) (*See further explanation*, p. 341.)

THE THIRD VENTRICLE

Is a narrow median fissure comprised between the optic thalami, and extending to the base of the brai
It present

Roof – Formed by under surface of fornix and by velum interpositum. (*See* morphologic
view, p. 348

Floor – Corresponds to interpeduncular space on under surface of cerebrum, and is form
from before backwards by the tuber cinereum & infundibulum, corpora albicantia, s
locus perforatus posticus. It is prolonged downwards and forwards into a recess, whi
passes, in the fœtus, into the iter ad infundibulum.

Lateral Walls – Formed by inner surfaces of optic thalami, which surfaces are bounded abo
by the striæ pineales, or superior penduncles of pineal gland, and are covered belo
by part of the grey matter of the 3rd ventricle prolonged upwards from its floor. – Th
lateral walls are joined together by the middle or soft commissure, a transverse ban
of grey matter continuous with the remainder of the grey matter of the 3rd ventricl

Ant. Boundary (*See* Fig. 526) – Formed by anterior crura of fornix. In front of these ar
the lamina cinerea and the anterior commissure. – Between the crura & the optic thalam
are the foramina of Monro, through which the lateral & 3rd ventricles communicat
and the anterior extremities of the velum interpositum pass from the 3rd into the later
ventricles to form the choroid plexuses of the latter. (*See* morphological view, p. 348

Post. Boundary (*See* Fig. 527) – Formed by posterior commissure, a transverse band
white fibres connecting posteriorly the optic thalami. Below this is the opening of t
aqueduct of sylvius or iter a tertio ad quartum ventriculum; above are the tubercu
quadrigemina & the pineal glan

For other recesses, see p. 348v.

FIG. 524.—THE THIRD AND FOURTH VENTRICLES. (Hirschfeld.)

16 third ventricle; 14, optic thalamus; 17, middle or soft commissure; 18, anterior crura of fornix, divided; 19, anterior commissure; 12, corpora quadrigemina and pineal gland. (*See further explanation*, p. 315.)

FIG. 525.—MESIAL SECTION OF ENTIRE BRAIN. (Sappey, Hirschfeld.)

21, superior peduncle of pineal gland or stria pinealis separating the upper and inner surfaces of the optic thalamus; 22, section of middle or soft commissure; 13, 14, fornix; 15, its left anterior crus, forming anterior boundary of foramen of Monro, 16; and passing down into corpus albicans, 17, in front of anterior commissure, 24; 20, pineal gland; 23, tubercula quadrigemina; 25, aqueduct of Sylvius. (*See further explanation*, p. 348vs.)

FIG. 526.—THE ANTERIOR BOUNDARY OF THE THIRD VENTRICLE, SEEN IN CORONAL SECTION. (Ellis.)

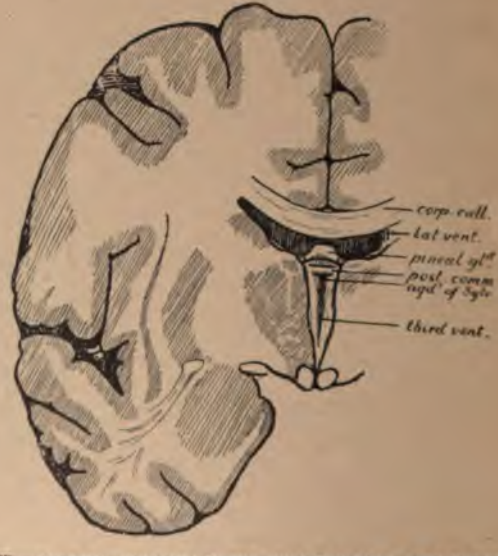


FIG. 527.—POSTERIOR BOUNDARY OF THE THIRD VENTRICLE, SEEN IN CORONAL SECTION.

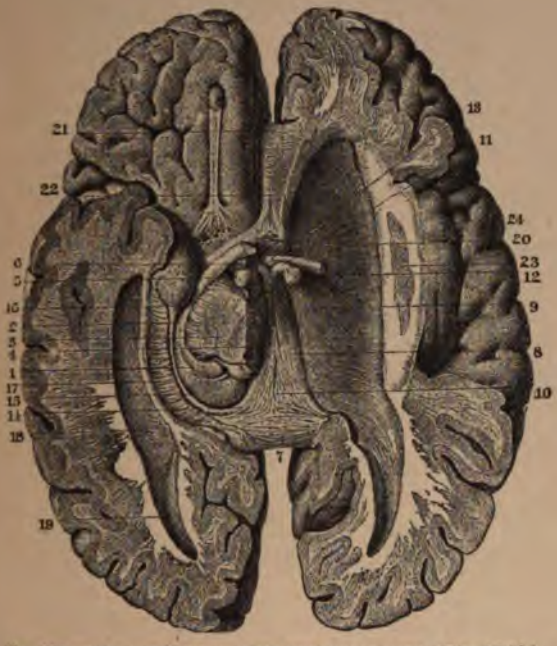


FIG. 528.—DEEP DISSECTION OF BRAIN FROM UNDERNEATH. (Hirschfeld.)

1, under surface of optic thalamus, showing the corpora geniculata internum and externum, and their connections with the optic tract. (*See further explanation*, p. 348uu.)

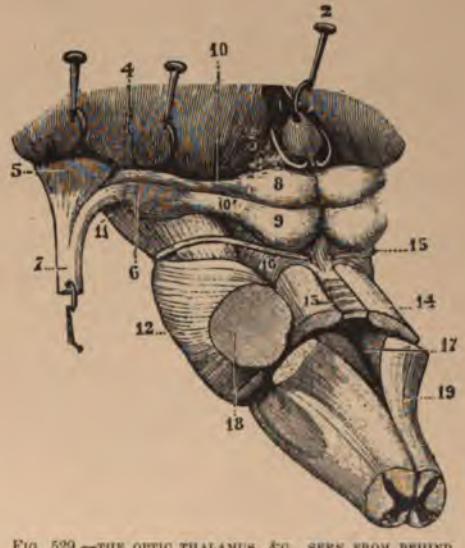


FIG. 529.—THE OPTIC THALAMUS, &C., SEEN FROM BEHIND. (Testut.)

3, pulvinar; 5 and 6, external and internal genicula bodies. (*See further explanation*, p. 348vv.)

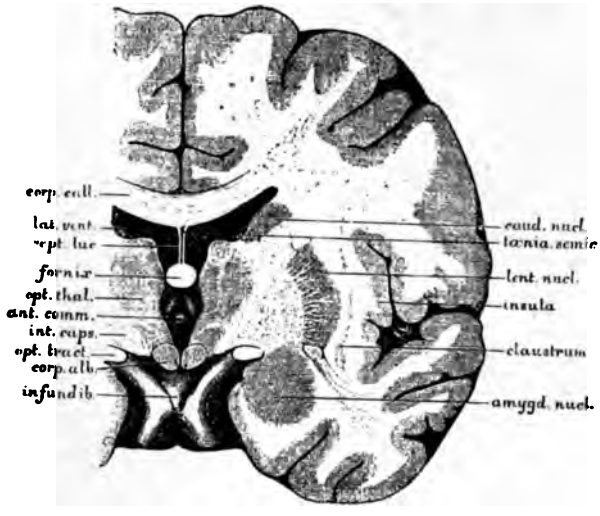


FIG. 526.—THE ANTERIOR BOUNDARY OF THE THIRD VENTRICLE, SEEN IN CORONAL SECTION. (Ellis.)

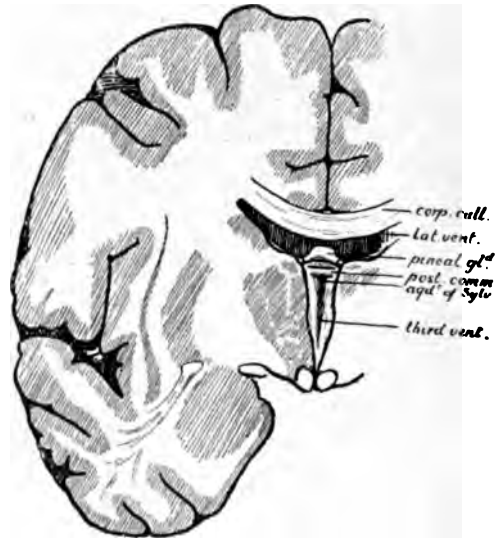


FIG. 527.—POSTERIOR BOUNDARY OF THE THIRD VENTRICLE, SEEN IN CORONAL SECTION.

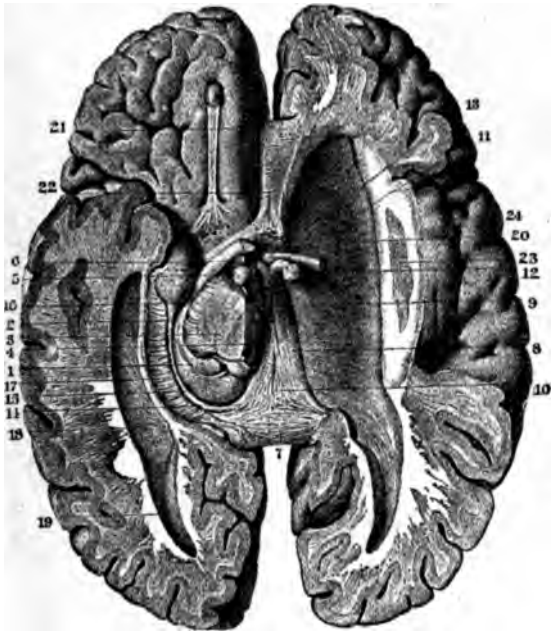


FIG. 528.—DEEP DISSECTION OF BRAIN FROM UNDERNEATH. (Hirschfeld.)

1, under surface of optic thalamus, showing the corpora geniculata internum and externum, and their connections with the optic tract. (*See further explanation*, p. 348uu.)

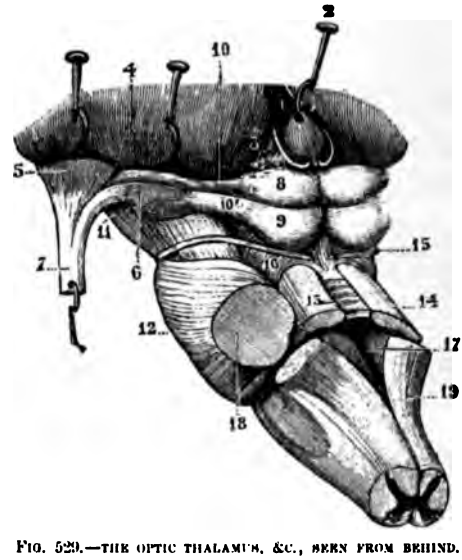


FIG. 529.—THE OPTIC THALAMUS, &C., SEEN FROM BEHIND. (Testut.)

3, pulvinar; 5 and 6, external and internal genicula bodies. (*See further explanation*, p. 348vv.)

OPTIC THALAMUS.

Large ovoid mass of grey matter white superficially, situated behind & internally to the corp striatum, and separated superficially from the caudate nucleus by the tænia semicircularis & t lamina cornea, and deeply from the lenticular nucleus by the posterior limb of the internal capsu (*see* Figs. 530, 515, 516, 517, 51 Present

ANT. EXTREMITY – Narrow, situated behind anterior crus of fornix; forms posteri boundary of foramen of Monr

POST. EXTREMITY OR PULVINAR – Broad & rounded. Projects into descending cornu lateral ventricle, and is continuous internally with tubercula quadrigemin

UPPER SURFACE – In front & externally it forms part of floor of lateral ventricle, a presents a slight elevation, the anterior tubercle: behind & internally it is covered b the velum interpositum & fornix, which rest upon it; these two parts of the upp surface are separated by a slight groove corresponding to the edge of the fornix. Th stria pinealis or superior peduncle of the pineal gland separates this surface from th inner surface. Quite posteriorly, just outside the stria pinealis, is slight triangula depression, broadest behind, the *trigonum habenul*

UNDER SURFACE – Continuous with posterior rounded extremity. In its posterior part i forms part of roof of descending cornu of lateral ventricle (*see* Figs. 518 & 514), an presents two small eminences, the *corpora geniculata internum et externum* (*see* Figs. 528 529), which are connected with inner & outer bands of origin of optic tract (*See* note pp. 315, and 228d). In its anterior part it rests upon the tegmentum of the cru cerebri and subthalamic region

INNER SURFACE – Forms lateral boundary of 3rd ventricle. Is joined to its fellow by th middle, soft, or grey commissure, and presents inferiorly the grey matter of the interio of the thalamus uncovered by the white. It is crossed superficially by a shallow groove running from the foramen of Monro towards the opening of the aqueduct of Sylviu The stria pinealis or superior peduncle of the pineal gland separates this surface fro the upper

OUTER SURFACE – Rests against the posterior limb of the inner capsule (Figs. 515, 516, 51 518), which separates it from the lenticular nucleu

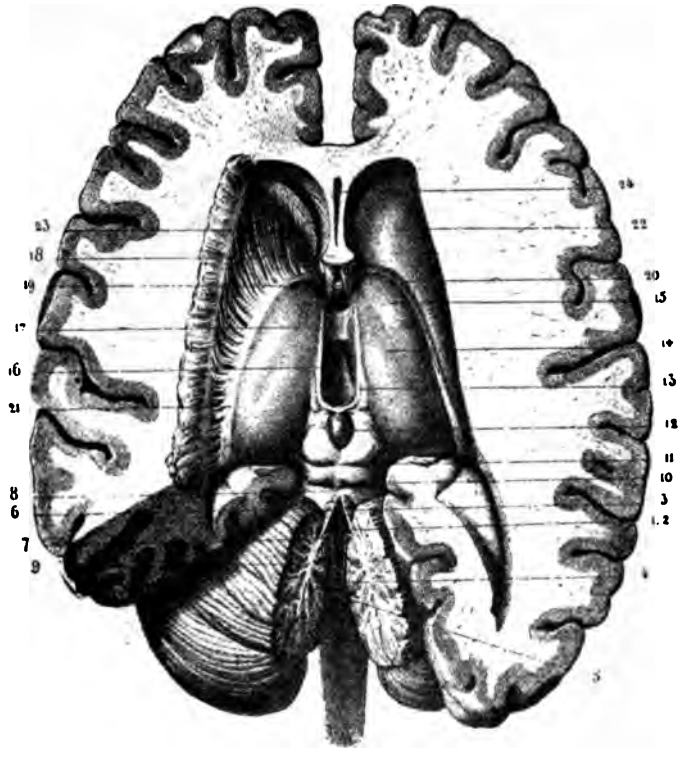


FIG. 530.—THE THIRD AND FOURTH VENTRICLES. (Hirschfeld.)

14, upper surface of optic thalamus, and groove, corresponding to the margin of the fornix and the choroid plexus, separating the portion covered by the above from the anterior tubercle, 15; 11, 12, tubercula quadrigemina and pineal gland; 13, superior peduncle of the pineal gland or stria pinealis: between the origin of this and the optic thalamus there is a small triangular depression, the trigonum habenulæ; in front of the anterior tubercle is seen the divided anterior crus of the fornix, 18, with, between the two, the foramen of Monro; between the two crura is the anterior commissure, 19. 16, third ventricle; 17, middle or soft commissure; 20, 21, lamina cornea and tænia semicircularis; 22, nucleus caudatus; 23, radiating fibres of internal capsule exposed through the removal of foregoing; 24, fifth ventricle; 1, 2, fourth ventricle; 3, valve of Vieussens, divided; 5, foramen of Magendie; 6, lingula; 7, nodule; 8, frænulum; 9, arbor vitæ; 10, 11, descending cornu of lateral ventricle.

The internal geniculate body is now, by advanced anatomists, detached from the optic thalamus on physiological grounds, and as belonging to the mid-brain: It is no longer referred to by the advanced school in connection with the optic thalamus.* It appears to have no functional connection with the optic nerve, and to be merely related to the intercerebral fibres of the tract and commissure, or fibres of Gudden (*see* p. 228d). It undergoes no change after removal of the eye-balls.

The optic thalamus is indistinctly divided into three nuclei external, internal, and antero-superior. In shape, the latter is not unlike the caudate nucleus. Its anterior and largest part forms the anterior tubercle; it then passes backward above and between the two other nuclei.

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* Dissectionally, however, there the two geniculate bodies are side by side, the *internal* and the *external*, and one exactly like the other.

THE MEDULLA OBLONGATA – (Surface Anatomy)

Is the upper enlarged part of the spinal cord (*).

Extends from lower border of Pons Varolii, above, to point of decussation of anterior pyramids, below, which point corresponds pretty nearly to upper border of atlas.

Flattened from above downwards and forwards, and presents:

ANTERO-INFERIOR ASPECT – Rests upon basilar groove.

POSTERO-SUPERIOR ASPECT – Forms part superiorly of floor of 4th ventricle, and is continuous inferiorly with posterior surface of cord.

Divided, as is the cord, into two lateral halves, by

ANTERO-MEDIAN FISSURE – Continuous below with that of cord, partly interrupted, however, by decussation of anterior pyramids. Terminates above, just below the pons, in a small recess, the foramen cæcum.

POSTERO-MEDIAN FISSURE – Continued above into ventricle of Arantius & postero-median fissure on floor of 4th ventricle, and below into postero-median fissure of cord.

SURFACE OF THE MEDULLA OBLONGATA.

Each half presents from before backwards between the two median fissures:

Anterior Pyramid – Pyramidal-shaped bundle of white fibres, the apparent prolongation of anterior column of cord; narrow below, enlarged and rounded off above, constricted just below the pons (†). Gives origin in its upper part to 6th cranial nerve.

Olivary Body – Oval prominent mass broader above than below, shorter than, but about as broad as, the pyramid. – It is separated from the pyramid by a narrow groove, which gives origin to the hypoglossal nerve, and from the lower part of which numerous arciform fibres are seen to proceed. These wind upwards and outwards round lower end of olivary body, sometimes crossing its surface. A few arciform fibres emerge from the anterior median fissure, and cross anterior aspect of pyramid (§).

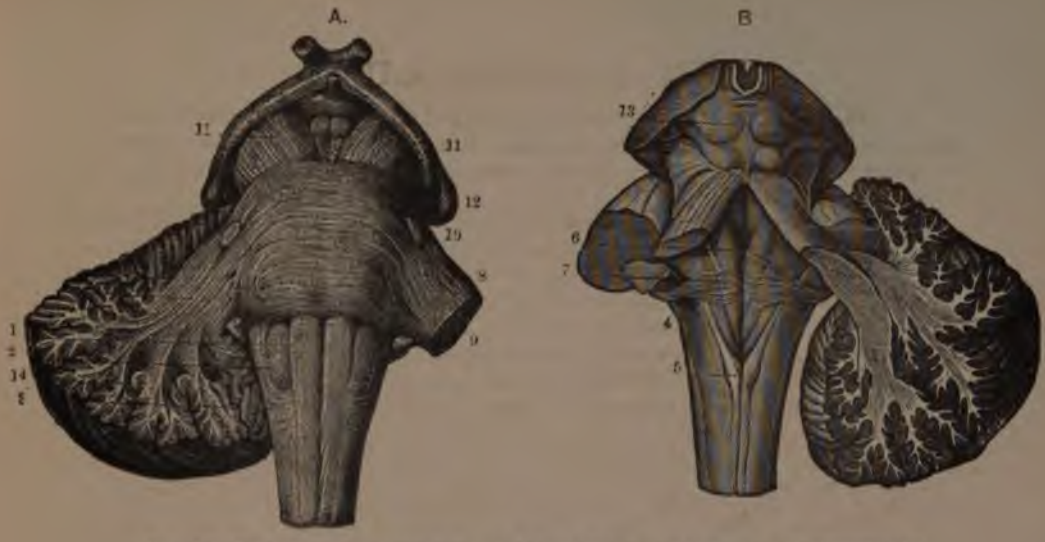
Lateral Tract – Is continuous, – apparently continuous, that is, – with lateral column of cord. It is broad below, where it includes all that part of the medulla comprised between anterior pyramid and restiform body; above it is pushed backwards, and is narrowed, by the projection of the olivary body. Here it corresponds to the groove between the olivary and restiform bodies, from which arise from above downwards the facial, auditory, glosso-pharyngeal, pneumogastric, & spinal accessory nerves.

Fasciculus Cuneatus – Is the outer and larger, while the

Posterior Pyramid or Fasciculus Gracilis – Is the inner & smaller portion of a wide & thick bundle of white fibres continuous below, – apparently continuous, – with the posterior column of cord, which bundle diverges from its fellow superiorly, and thus both exposes the grey matter of the floor of the 4th ventricle and forms the lower part of the lateral boundary of that cavity. This wide & thick bundle used to be called, and must still be called in dissectional anatomy, *the* restiform body (¶). – From its inner and dorsal aspect there projects inwards a thin lamina of white matter termed the *ligula*, which, at the point of divergence of the two restiform bodies, is joined to its fellow of the opposite side by means of a somewhat wider lamina continuous with both ligulæ, the *obex*. Opposite the apex of the calamus scriptorius the posterior pyramid presents an enlargement, the *processus clavatus*. In front of the processus cuneatus, behind & a little below olivary body, is a small greyish eminence, the *grey tubercle of Rolando* (the upper part of the fasciculus of Rolando), formed by the projection of the substantia gelatinosa.

Grey Matter of Floor of 4th Ventricle – *Vide* Fourth Ventricle, page 326.

*, †, §, ¶ *See notes, page* 348x.



FIGS. 532, 533, 534.—ANTERIOR, POSTERIOR, AND LATERAL VIEWS OF THE MEDULLA AND MESOCEPHALON. (A & C, Hirschfeld; B, Sappey, Quain, Hirschfeld.)

1, 2, 3, anterior pyramid, olivary body, lateral tract; 4, 5, 6, processus cuneatus, posterior pyramid, grey matter of floor of fourth ventricle; 7, posterior median fissure, with the lines transversæ; on either side of these parts there are seen, in B, the inferior peduncle of the cerebellum divided on the left side, and the middle and superior peduncles divided on both sides; 8, 9, 10, pons Varolii, with the middle peduncles of the cerebellum, and the apparent origins of the fifth nerve; 11, 12, crura cerebri, with the corpora geniculata and the optic tract and commissure, behind which latter there are seen, in A, the tuber cinereum with the infundibulum and pituitary body, the corpora albicantia, and the locus perforatus posticus; 13, tubercula quadrigemina, with, in B, the divided optic thalami, the back part of the third ventricle, the posterior commissure, and the frænulum; 14, arbor vitæ.

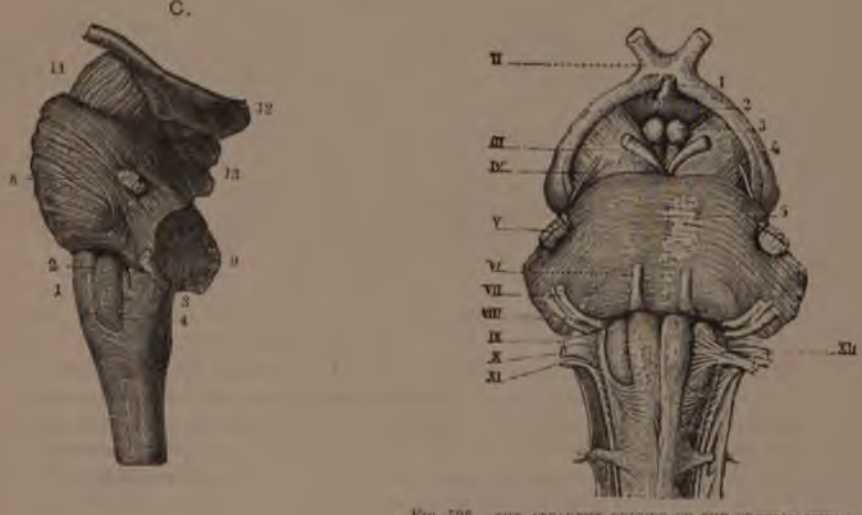


FIG. 535.—THE APPARENT ORIGINS OF THE CRANIAL NERVES, EXCEPT THE FIRST, NUMBERED IN ROMAN FIGURES. (Sappey.)

THE CEREBELLUM.

The cerebellum is oblong from side to side and flattened from above downwards, and presents two surfaces and a circumference. It consists of two lateral hemispheres connected by a median lobe, the vermiform process, which is divided into upper and lower vermes.

The circumference of the cerebellum is notched in front and behind. The anterior notch, or *incisura semilunaris*, is the widest; it embraces the superior peduncles and the testes. The posterior notch, or *incisura marsupialis*, is narrower and deeper, and receives the falx cerebri. The circumference of the cerebellum is divided into upper and lower lips by the great horizontal fissure, which deeply indents the organ externally and behind, in front this fissure is widely open for the emergence of the cerebellar peduncles.

The *upper surface* is flattened on either side, and slightly elevated in the centre. Quite anteriorly it presents the *Lingula*, consisting of four or five narrow

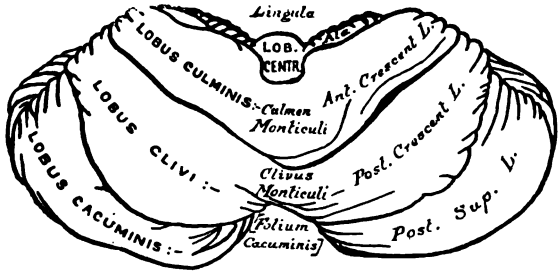


FIG. 536.—UPPER SURFACE OF THE CEREBELLUM, DIAGRAMMATIC.

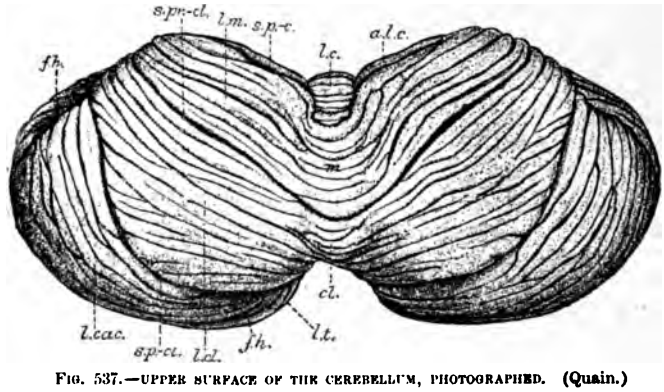


FIG. 537.—UPPER SURFACE OF THE CEREBELLUM, PHOTOGRAPHED. (Quain.)
(*See expl.*, page 325.)

folia prolonged upwards on the valve of Vieussens. Behind this is the *Lobus Centralis*, somewhat broader, but also of small extent from side to side; the lobus centralis lies at the bottom of the semilunar notch, and is but little seen from above; but laterally it gives off two more prominent processes, the alæ, which partially surround the semilunar notch. Behind the foregoing comes the much broader *Lobus Culminis*, consisting of a central portion, the *culmen monticuli*, belonging to the superior vermiform process, and of two lateral portions, the *anterior crescentic* lobes, belonging to the lateral hemispheres. The culmen monticuli constitutes the highest part, or monticulus, of the superior vermiform process. The anterior crescentic lobe completes the lateral boundary of the semilunar

notch, and forms the anterior half of what was formerly called the anterior or square lobe. Behind the anterior crescentic lobe, is the *posterior crescentic lobe*, forming the back part of

FIG. 538.—UNDER SURFACE OF CEREBELLUM, WITH MEDULLA AND PONS VAROLII.
(Hirschfeld, Sappey, Quain.)

1, 1, inferior vermiform process; 2, 2, valley or vallecula; 3, 3, 3 (from below upwards), posterior inferior lobe, slender lobe, digastric lobe; 4, amygdala or tonsil; 5, flocculus; 6, 7, pons Varolii; 8, middle peduncle of cerebellum; 9, medulla oblongata; 10, 11, anterior part of great horizontal fissure; 12, 13, motor and sensory roots of fifth nerve; 14, sixth nerve; 15, 16, 17, facial nerve, portio intermedia of Wrisberg, and auditory nerve; 18, 19, 20, glosso-pharyngeal, pneumogastric, and spinal accessory nerves; 21, hypoglossal nerve.

the former anterior or square lobe; centrally, the posterior crescentic lobe is joined to its fellow by the *clivus monticuli*, which forms the descending part of the monticulus. This *clivus* and the posterior crescentic lobes constitute the *Lobus Clivi*. Quite at the back part of the upper surface of the cerebellum there comes the *Lobus Cacuminis*,

FIG. 539.—UNDER SURFACE OF THE CEREBELLUM, WITH MEDULLA LIFTED UP AND THE TONSIL REMOVED.
(Hirschfeld.)

1, uvula, with the furrowed band on either side; 4, nodule, on either side of which is the inferior medullary velum, or commissura ad flocculum, 5; 3, inferior vermiform process; 6, flocculus.

forming the upper boundary of the great transverse fissure. The lobus cacuminis consists centrally of the *folium cacuminis*, and laterally of the *posterior superior lobes*. Viela

the tuber valvulæ of the under surface, the folium cacuminis forms the anterior boundary of the marsupial notch. It constitutes the narrow link between the two expanded *posterior superior lobes.*

The *under surface* of the cerebellum is rounded and elevated laterally, and depressed in the middle line. Quite posteriorly, and at the sides, this surface presents the *posterior inferior lobe*, which forms the lower boundary of the great horizontal fissure. This lobe constitutes the lateral part of the *Lobus Tuberis*. The central portion of the latter is the *tuber valvulæ*, which, with the above-mentioned folium cacuminis of the upper surface, bounds anteriorly the marsupial notch. Laterally, there is usually associated with the tuber valvulæ the *slender lobe*, or *lobus gracilis*, which is not directly connected with it, however. In front of the foregoing is the *Lobus Pyramidis*, consisting centrally of the pyramid, and laterally of the digastric or biventral lobes. More anteriorly and centrally, and embraced by the foregoing, is the *Lobus Uvulæ*, consisting of the uvula and

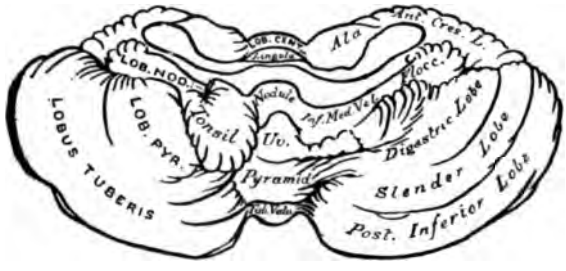


FIG. 540. UNDER SURFACE OF THE CEREBELLUM, THE LEFT TONSIL BEING REMOVED, DIAGRAMMATIC.

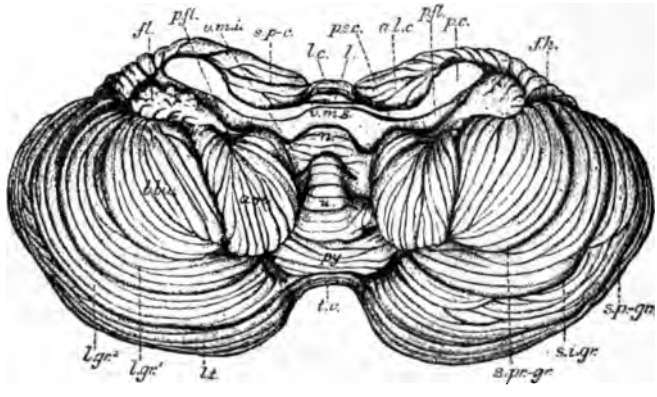


FIG. 541.—UNDER SURFACE OF THE CEREBELLUM, PHOTOGRAPHED. (Quain.) (*See expl.*, p. 325.)

the two amygdalæ or tonsils. The *uvula* is a somewhat triangular elevation, placed between the two *amygdalæ*, to which it is connected by a narrow ridge, *the furrowed band*, lying deeply in the valley, and crossed by transverse furrows. In front of the foregoing, but more spread out from side to side, is the *Lobus Noduli*, consisting centrally of the

nodule, and, on either side, of the inferior medullary velum and the flocculus. The *nodule* is the narrow pointed extremity of the uvula; it projects into the fourth ventricle.

FIG. 542.—ARBOR VITÆ AND CORPUS DENTATUM.
(Hirschfeld.)

FIG. 543.—SECTION ACROSS CEREBELLUM SHOWING POSITION OF NUCLEI IN MEDULLARY CENTRE. (Stilling, Quain.)

The *flocculus* is a prominent tuft, divided into several laminæ, and situated below and behind the middle peduncle of the cerebellum. It is connected with the nodule by a thin valvular fold of white substance, the *inferior medullary velum*, which is continuous with the central white stem of the cerebellum; the inferior medullary velum is partly concealed by the tonsil.

The antero-posterior section of the cerebellum presents the well-known appearance termed the arbor vitæ. The central white core, or corpus trapezoides, sends stems to the various lobules, and from these a branch is given off to each folium. Core, stem, and branches are surrounded by the external grey matter.

In the medullary core of the lateral hemisphere is a collection of grey matter, the corpus dentatum. This much resembles the olivary nucleus of the medulla. On section it shows a thin wavy lamina of grey matter folded upon itself so as to form a

capsule open towards the mesial plane, and from which issue the majority of the fibres of the superior peduncle. There are also three other smaller masses of grey matter in the medullary core, all lying just internally to the hilum of the corpus dentatum, and named the nuclei **emboliformis, globosus,** and **fastigii.**

Of the three cerebellar peduncles which enter or leave the medullary centre, the *middle* one is the largest. It is formed by the transverse fibres of the pons, and enters the cerebellar hemisphere externally to the two others, widely separating the lips of the great horizontal fissure. It consists of two decussating bundles; one is derived from the upper pontine fibres, and radiates towards the lower part of the cerebellar hemisphere; the other is derived from the lower pontine fibres, and radiates towards the upper part of the hemisphere. The *superior peduncle* is mainly derived from the corpus dentatum. Emerging from the cerebellum on the inner side of the middle peduncle, it ascends towards the testes, forming part of the roof and lateral boundary of the fourth ventricle; it is joined to its fellow by the valve of Vieussens. The *inferior peduncle*, or restiform body of the medulla (*see* note, p. 348x), emerges from the white matter of the cerebellum between the two others. It is at first directed forwards, but it soon curves downwards and inwards, forming the lower part of the lateral boundary of the fourth ventricle.

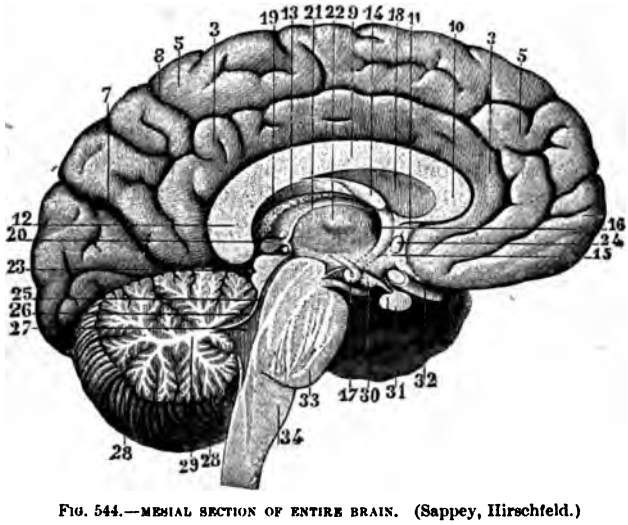


FIG. 544.—MESIAL SECTION OF ENTIRE BRAIN. (Sappey, Hirschfeld.)

9, corpus callosum, with, 10 and 11, its beak or rostrum, and 12, its posterior extremity or splenium, the latter forming the upper boundary of the middle portion of the transverse fissure; 18, septum lucidum; 14, section of fornix, with, 15, its anterior crus passing down in front of the foramen of Monro, 16, and behind the anterior commissure, 24, to the corpus albicans, 17, in which it twists upon itself to re-ascend to the optic thalamus, forming the bundle of Vicq d'Azyr; 19, choroid plexus; 22, middle or grey commissure on inner surface of optic thalamus; 23, tubercula quadrigemina; 20, pineal gland, with, 21, its superior peduncle or stria pinealis separating the inner and upper surfaces of the optic thalamus: just below and in front of the pineal gland and the commencement of its peduncle is the section of the posterior commissure; 28, arbor vitæ of cerebellum; 26, valve of Vieussens; 27, fourth ventricle; 25, aqueduct of Sylvius; 30, 31, 32, tuber cinereum, with the infundibulum and pituitary body, and the section of the optic nerve; 33, 34, section of pons and medulla.

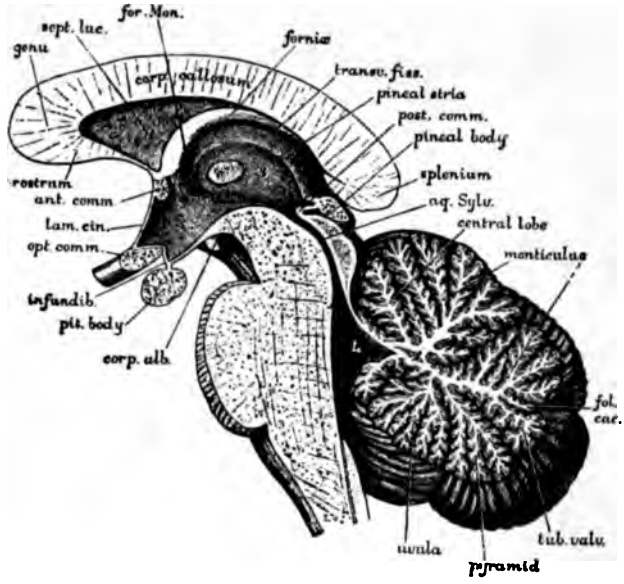


FIG. 545.—MEDIAN SECTION, SHOWING THIRD & FOURTH VENTRICLES, AQUEDUCT OF SYLVIUS, PONS VAROLII, CEREBELLUM, &c. (Quain).

EXPLANATION OF FIGURES 537 AND 541.

Fig. 537 : ***l.c.***, **lobulus centralis;** ***a.l.c.***, **ala lobuli centralis ;** ***m.***, **culmen monticuli ;** ***l.m.***, **lobus culminis ;** ***cl.***, **clivus ;** ***l.cl.***, **lobus clivi ;** ***l.cac.***, **lobus cacuminis ;** ***l.t.***, **lobus tuberis ;** ***s.p.-c.***, **sulcus post-centralis ;** ***s.pr.-cl.***, **sulcus preclivalis ;** ***s.p.-cl.***, **sulcus postclivalis ;** ***f.h.***, ***f.h.***, **fissura horizontalis magna.**

Fig. 541 : ***l***, **lingula ;** ***l.c.***, **lobulus centralis ;** ***a.l.c.***, **ala lobuli centralis ;** ***s.p.-c.***, **sulcus postcentralis ;** ***v.m.s.***, **velum medullare superius ;** ***p.s.c.***, **pedunculus cerebelli superior ;** ***p.c.***, **pedunculi cerebelli medius et inferior ;** ***n***, **nodulus ;** ***v.m.i.***, **velum medullare inferius ;** ***p.fl.***, **pedunculus flocculi ;** ***fl.***, **flocculus ;** ***u.***, **uvula ;** ***am.***, **amygdala ;** ***pyr.***, **pyramis ;** ***l.bic.***, **lobus biventralis ;** ***t.v.***, **tuber valvulæ seu posticum ;** ***l.t.***, **lobus postero-inferior ;** ***l.gr.***^{1}, **lobulus gracilis anterior ;** ***l.gr.***^{2}, **lobulus gracilis posterior ;** ***s.pr.-gr.***, **sulcus pregracilis ;** ***s.i.-gr.***, **sulcus intra-gracilis ;** ***s.p.-gr.***, **sulcus postgracilis ;** ***f.h.***, **fissura horizontalis magna.**

The vallecula has been somewhat opened out to display the parts of the lower worm.

THE FOURTH VENTRICLE.

Rhomboidal cavity prolonged into two lateral recesses, which is bounded by the medulla oblongata & mesocephalon below & in front and the cerebellum above & behind, and closed in inferiorly by a layer of pia mater & epithelium, the *tela choroidea*. Presents

FLOOR - Lozenge-shaped, oblique downwards & backwards; covered by a stratum of grey matter, from the cells in which there arise several of the cranial nerves, wholly or in part; bounded on either side below by the posterior pyramids & restiform bodies,* and above by the processus e cerebello ad testes. Presents the following parts, which give rise to the appearance termed the *calamus scriptorius*:-

Postero-median Fissure - Continued above into the aqueduct of Sylvius or iter a tertio ad quartum ventriculum, below into the ventricle of Arantius or upper expanded part of the central canal and into the postero-median fissure of the cord.

Striæ Acusticæ;

Fovea Inferior, with the Trigona Hypoglossi & Vagi, & the Tuberculum Acusticum;

Fovea Superior, with the Eminentia Teres, & Locus Cœruleus.

ROOF — Formed above by the superior peduncles of the cerebellum & the valve of Vieussens, below by the tonsils, the inferior vermiform process with the uvula, the nodule, and the inferior medullary velum.

LATERAL BOUNDARIES - Formed by the superior peduncles of the cerebellum above, and by the diverging restiform bodies & posterior pyramids below.

UPPER EXTREMITY - Presents the opening of the aqueduct of Sylvius or iter a tertio ad quartum ventriculum.

LOWER EXTREMITY - Presents an opening in the tela choroidea, the foramen of Magendie, situated opposite the apex of the calamus scriptorius. There is another smaller opening at the extremity of each lateral recess, the foramen of Key & Retzius. Through these openings the ventricular cavities of the brain communicate with the subarachnoidean space of the brain & cord.

Choroid Plexuses of 4th Ventricle - *Vide* intra-cerebral portion of the pia mater, p. 306.

* Advanced anatomists would put it "cuneate fasciculi below and restiform bodies above." (*See* note, p. 348x.) But there is no outward demarcation visible warranting the distinction and the two names in regard to dissectional anatomy. A leading anatomist gets over the difficulty by picturing the medulla, not of the adult, but of the fœtus.

Floor and Lateral Recesses of the Fourth Ventricle.*

The *striæ acusticæ* divide the floor of the 4th ventricle into two triangles, a lower one and an upper one. They emerge from about the middle of the postero-median fissure, and pass out to the lateral recesses, crossing the most prominent part of the tuberculum acusticum. They appear to join the large outer root of the auditory nerve, but some are believed to pass on to the flocculus.

The INFERIOR TRIANGLE presents towards its middle a depression triangular in shape, the *inferior fovea*. The fovea has its apex directed upwards, reaching to the striæ; its base is turned downwards, and is prolonged into two grooves or limbs passing, the inner one downwards and inwards, the outer one downwards and outwards. By the fovea and its limbs the inferior triangle is thus divided into three triangular areæ of nearly equal size.

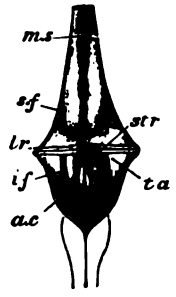


FIG. 546.—FLOOR OF FOURTH VENTRICLE. NATURAL SIZE.

m.s., postero-median fissure; *str.*, striæ acusticæ; *l.r.*, lateral recess; *i.f.*, fovea inferior; *s.f.*, fovea superior; *a.c.*, ala cinerea, or trigonum vagi; *t.a.*, tuberculum acusticum. (Quain.)

The area between the two limbs is somewhat darker in colour than the neighbouring parts, and is called the *ala cinerea*, or *trigonum vagi*: It contains the principal nucleus of the pneumogastric nerve, and also, quite inferiorly, a portion of the nucleus of the spinal accessory nerve.

Internally to the inner limb of the fovea, between it and the lower part of the postero-median fissure, is an area lighter in colour termed the *ala alba interna*, or *trigonum hypoglossi*. This corresponds both to the upper part of the tract of cells which form the nucleus of the hypoglossal nerve, and also to the lower part of the fasciculus teres, or intrapontine portion of the facial nerve.

Externally to the outer limb of the fovea is another lighter area, the *ala alba externa*, physiologically designated the *tuberculum acusticum*: The upper part of this, the part lying close to, – and prolonged somewhat beneath the striæ, and to near the lateral recess of the ventricle, – contains the principal auditory nucleus; the lower part contains the upper prolongation of the column of cells which form the principal nucleus of the glosso-pharyngeal and pneumogastric nerves.

The nuclei of the hypoglossal nerve and of the accessory portion of the spinal accessory are prolonged for some distance into the grey matter of the cord, the former in front of the central canal, and the latter behind it.

The SUPERIOR TRIANGLE also presents a triangular depression, the *fovea superior*, lying in a line with the inferior fovea, from which it is separated by the tuberculum acusticum and the striæ. Internally to the superior fovea, between it and the upper part of the postero-median groove, is an elongated eminence, the eminentia teres, situated in a line with the trigonum hypoglossi, and formed in part by the ascending intrapontine portion of the facial nerve. The fovea is prolonged superiorly into a shallow dark depression, the *locus cæruleus*, corresponding to the subjacent *substantia ferruginea*.

In the superior triangle, just above the striæ, and close to the postero-median fissure, is the *nucleus of the 6th nerve*. Externally to this, between it and the superior fovea,

* These two pages would best be read in conjunction with the account of the deep origins of the cranial nerves given at the beginning of this volume, pp. 152k to 152t.

is the *nucleus of the 7th nerve*, but more deeply situated (*see* p. 152m). Directly above, and in a line with the nucleus of the 7th nerve, in the upper narrowing part of the floor, is the *motor nucleus of the 5th nerve*, also somewhat deeply situated. Higher up still, on the floor of the aqueduct of Sylvius, are, anteriorly, the *nucleus of the 3rd nerve*, and, posteriorly, the *nucleus of the 4th nerve*. Just externally to these nuclei, is the *nucleus of the descending root of the 5th nerve* (upper sensory nucleus).

Besides the above, the 5th nerve has two other nuclei, one (middle sensory nucleus) situated in the formatio reticularis externally to the motor nucleus, and another (corresponding to the ascending root) in the substantia gelatinosa of Rolando as it caps the posterior horn of the grey matter in the lower part of the medulla and upper part of the spinal cord. (*See* Figs. 358I & J.)

The main nucleus of the auditory nerve is in the acustic tubercle above described, from which there mainly arise both the deep root, which passes to the inner side of the superior peduncle of the cerebellum, and the superficial root, which crosses the peduncle externally. There is a small accessory auditory nucleus at the point of junction of the two roots, just in front of the peduncle; there are also some multipolar cells in the midst of the fibres of the superficial root.

At the widest part of the 4th ventricle there is a small *lateral recess* extending over the upper part of the restiform body.

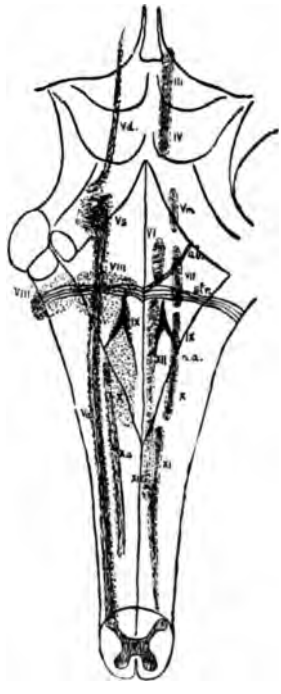


FIG. 547.—NUCLEI ON FLOOR OF FOURTH VENTRICLE. (Quain.)

(*See larger diagram and explanation*, pp. 152k to 152t.)

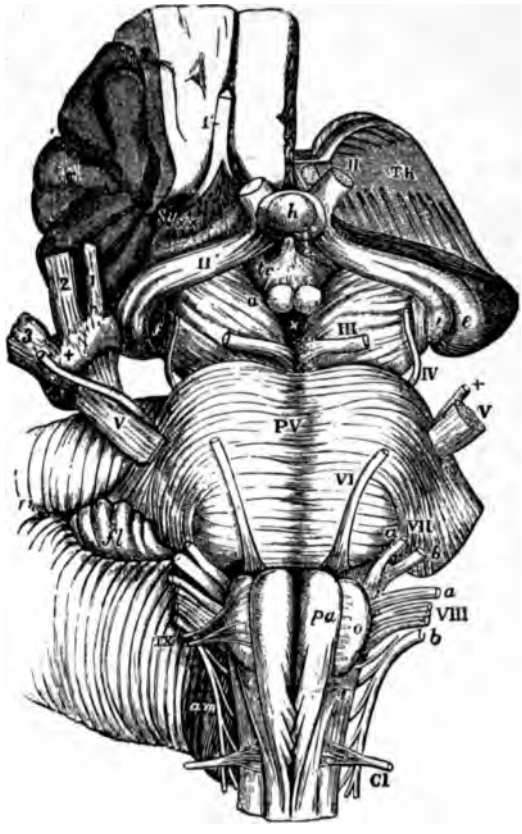


FIG. 548.—MEDULLA, PONS, CRURA CEREBRI, AND OTHER CENTRAL PARTS OF THE BRAIN, SHOWING APPARENT ORIGINS OF THE CRANIAL NERVES, THE SECOND AND THE FOURTH EXCEPTED. (Allen Thomson, Quain.)

The nerves are marked in Roman figures, I. to IX., according to Willis's classification. II., optic nerve, with the optic tract, II.', and the internal and external geniculate bodies, *i*, *e*; III., third nerve or motor oculi; IV., fourth nerve, trochlearis or patheticus; V., the two roots, anterior small or motor, and posterior large or sensory, of the fifth nerve; VI., sixth nerve; VII., facial nerve, with the auditory nerve, marked *b*, to its outer side; VIII., pneumogastric nerve, with the glosso-pharyngeal nerve, marked *a*, above it, and the spinal accessory nerve, marked *b*, below it; *pa*, anterior pyramid; *o*, olivary body.

THE MESOCEPHALON — (Surface Anatomy)

Is the connecting link between the cerebrum, cerebellum, & medulla oblongata. It consists of: –
Pons Varolii or *Tuber Annulare*, with the superficial & deep transverse fibres of the *Middle Peduncles of the Cerebellum*;
Crura Cerebri, divided into *under or fasciculated portion* and *upper part or tegmentum*;
Inferior Peduncles of the Cerebellum, and *Superior Peduncles* with the *Valve of Vieussens*;
Tubercula Quadrigemina & *Pineal Gland.*

Pons Varolii or Tuber Annulare – Broad transverse band of white fibres which arch like a bridge from one hemisphere of the cerebellum to the other, forming laterally the middle peduncles of the cerebellum. Presents:

UNDER SURFACE – Marked by a median shallow groove occupied by the basilar artery, and due to the prominence on either side of the middle line resulting from the prolongation of the pyramids underneath the transverse fibres. Gives off laterally the two roots, anterior small or motor, posterior large or sensory, of the 5th pair of cranial nerves

UPPER BORDER – The most prominent & the most convex, from beneath which the crura cerebri are seen to emerge.

LOWER BORDER – Less prominent & less convex, into which the anterior pyramids, olivary fasciculi, & lateral tracts of the medulla are seen to penetrate, and from the anterior aspect of which the 6th cranial nerves are sometimes given off. – Laterally the pons Varolii is continued into the two

Middle Peduncles of the Cerebellum or Crura Cerebelli – Which form its two lateral portions.

Crura Cerebri – Two thick cylindrical or slightly flattened bundles of white fibres about ¾ of an inch long & rather wider in front than behind, which emerge from the anterior border of the pons and pass forwards & outwards to the corpora striata & optic thalami. They are crossed externally by the 4th nerve & inferiorly by the optic tract, the anterior border of which latter is slightly adherent to them. Their inner border bounds posteriorly the interpeduncular space, and presents a slight groove, the *sulcus oculomotorius*, from which arises the 3rd nerve, and which separates internally the inferior portion of the crus, *pes* or *crusta*, from the upper portion, or *tegmentum*. There is a similar groove on the outer side. These groves correspond to the locus niger.

Inferior Peduncles of the Cerebellum or Processus e Cerebello ad Medullam – Two thick bundles of white fibres which descend from the inner & under part of the cerebellum to the back of the medulla, where they join the processus cuneati. They form the lower part of the lateral boundary of the 4th ventricle. They are, from the dissector's point of view, the two restiform bodies described from above downwards, instead of being described, as previously, from below upwards.

Superior Peduncles of the Cerebellum or Processus e Cerebello ad Testes – Two thick bundles of white fibres which ascend from the upper & inner part of the cerebellum to the testes, forming part of the roof & of the lateral boundary of the 4th ventricle. They are connected together by the

Valve of Vieussens – Thin transparent lamina of white matter narrow in front, where it presents a slight median ridge, the frenulum, and, on either side of this, the roots of the 4th nerve, broader behind, where it is continued into the under surface of the superior vermiform process and is crossed by the lingula, which is formed by a few transverse bands of grey matter prolonged upwards from the cerebellum. It forms the roof of the aqueduct of Sylvius & a part of the roof of the 4th ventricle.

Tubercula Quadrigemina – Four small rounded eminences separated by a crucial depression, and situated below the posterior extremity or splenium of the corpus callosum, the velum interpositum intervening, above & behind the posterior commissure & the 3rd ventricle, above & in front of the superior peduncles of the cerebellum & the valve of Vieussens.

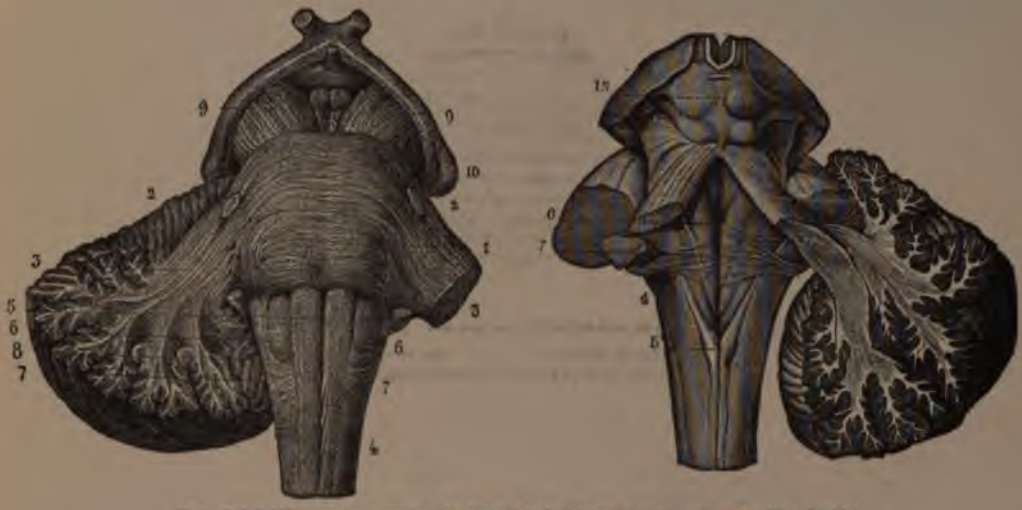
ANTERIOR OR NATES – Are larger, darker, slightly oblong from before backwards, and connected with the *external geniculate body* & the commencement of the optic tract by broad white bands, the *anterior or superior brachia.*

POSTERIOR OR TESTES – Are smaller, lighter in colour, more exactly rounded, and connected, – apparently, at least (*see* note, p. 315), – with the *internal geniculate body* & the commencement of the optic tracts by narrower bands, the *posterior or inferior brachia.*

Pineal Gland or Conarium – Small conical reddish-grey body situated between the nates, retained in position by a fold of pia mater derived from the under surface of the velum interpositum, and connected with the remainder of the cerebrum by means of a few transverse fibres belonging to the posterior commissure, and also by means of its

PEDUNCLES, which run forwards over upper & inner part of optic thalami to anterior crura of fornix, with which they unite.

The pineal gland consists of a number of follicles joined together by a little connective tissue, and containing a transparent viscid fluid and a quantity of gritty sabulous matter, the acervulus cerebri.



FIGS. 549 & 550.—UNDER SURFACE OF MEDULLA & MESOCEPHALON. (Sappey, Hirschfeld.)

1, pons varolii, continued on either side into the middle peduncles of the cerebellum, 3; 2, superficial origin of the fifth nerve; 4, medulla oblongata; 5, anterior pyramid; 6, olivary body; 7, tubercle of Rolando; 8, lateral tract; 9, crura cerebri; 10, corpora geniculata & optic tracts.

FIG. 550.—THE MESOCEPHALON AND MEDULLA SEEN FROM BEHIND, SHOWING THE THREE PAIRS OF CEREBELLAR PEDUNCLES. (Hirschfeld, Sappey, Quain.)

The three cerebellar peduncles are cut short on the left side; on the right side the hemisphere is cut away obliquely, so as to show its connections with the superior and inferior peduncles. 1, postero-median groove on floor of fourth ventricle; 2, auditory striæ emerging therefrom about the middle of the ventricle; 3, inferior peduncle or restiform body; 4, funiculus gracilis; 5, superior peduncle; on the right side the dissection shows the superior and inferior peduncles crossing each other as they enter the central white substance of the cerebellum; 6, fillet; 7, lateral grooves separating the crusta and tegmentum of the crura cerebri; 8, tubercula quadrigemina.

The term "Pons Varolii" is now used in two different senses, (1) as signifying the broad transverse band of white fibres which arch like a bridge from one hemisphere of the cerebellum to the other: this is the original meaning of the term as used in dissectional Anatomy; and (2) as a comprehensive designation of the *ensemble* of the connective link between the cerebrum, cerebellum, & medulla oblongata. In the Tablets proper, which deal with *dissectional* Anatomy, the term "Pons Varolii" is restricted to its original and obvious meaning, and the term "Mesocephalon" has been adopted in substitution for the same as used in its wider sense. In the Notes on *structural Anatomy* the term "Pons Varolii" has been used in its more comprehensive sense.

It is hoped that the term "Mesocephalon" will not be confounded with the apparently somewhat similar term of embryological significance, "Mesencephalon." The

Mesocephalon includes both (1) the Pons Varolii and the crura cerebelli which belong to the Epencephalon, and (2) the pineal gland, which belongs to the Thalamencephalon (*see* Development of the Brain, p. 348rr).

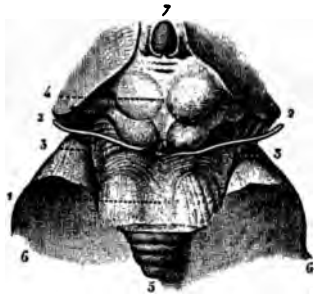


FIG. 551.—THE MESOCEPHALON, SEEN FROM BEHIND. (Sappey, Hirschfeld.)

1, valve of Vieussens; 2, fourth nerves; 3, fillet; 4, tubercula quadrigemina; 5, lingula turned backwards; 6, crura cerebelli, divided; 7, pineal gland turned forwards.

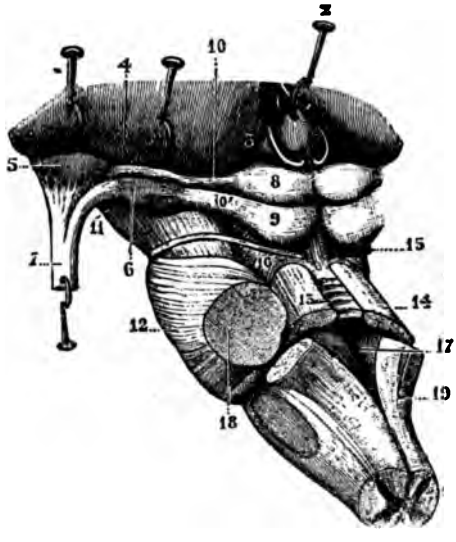


FIG. 552.—CORPORA GENICULATA AND TUBERCULA QUADRIGEMINA, WITH THE ORIGINS OF THE OPTIC TRACT. (Testut.)

(*See* p. 228d; *see expl. of figure*, p. 348vv.)

COVERINGS OF THE BRAIN AND CORD; LARGE VESSELS.

(*See Minute Vascularisation of the Brain, page* 348y.)

COVERINGS of the BRAIN & CORD—1st Tablet.

The immediate coverings of both are three in number, and, though presenting marked differences, they bear the same names, *dura mater, arachnoid, & pia mater.*

THE DURA MATER — Is a thick, dense, fibrous membrane, which is lined internally by the parietal layer of the arachnoid.

Dura Mater of the Brain - Forms the internal periosteum of the skull; it is prolonged round all the cranial nerves, blending with their sheaths and becoming at their point of exit continuous with the pericranium; it is also prolonged into the orbit.

Its outer surface is rough & fibrillated; it is most adherent opposite the sutures at the base of the skull, and presents superiorly numerous glandulæ Pacchionii.

Its inner surface is smooth; it sends three processes inwards, the *falx cerebri* and the *tentorium & falx cerebelli*, in the attached margins of which processes are respectively contained the superior longitudinal, the lateral & superior petrosal, & the occipital sinuses, the falx cerebri having also the inferior longitudinal sinus in its free margin.

Its arteries are derived from the middle & small meningeal, and from the meningeal branches of the anterior & posterior ethmoidal, internal carotid, ascending pharyngeal, occipital & vertebral, which arteries however supply principally the bones of the skull. Its veins, with the exception of the two which accompany the middle meningeal, join with the diploic veins and open into the sinuses. – Its nerves are small branches from the fourth cranial nerve, the Casserian ganglion, the ophthalmic branch of the fifth, the eighth, & the sympathetic.

Dura Mater of the Cord - Differs from that of the brain in that it does not form the internal periosteum of the bodies & laminæ of the vertebræ, which periosteum is a distinct fibrous membrane separated from the dura mater by loose areolar tissue & by a plexus of veins, in that it sends no prolongations inwards, contains no sinuses, and forms, especially in the cervical & lumbar regions, but a loose sheath round the cord and the roots of the spinal nerves.

It is attached *superiorly* to the circumference of the foramen magnum, and *anteriorly* it is slightly adherent along its whole length to the posterior common ligament of the spine.

Laterally when viewed from *within*, it is seen to give attachment to the processes of the ligamentum denticulatum, and to present a double series of foramina for the passage of the anterior & posterior roots of the nerves; when viewed from *without* it is seen to form a separate sheath to the roots of the nerves as far as their point of junction, and then to be continued upon the nerves, forming part of their neurilemma.

Opposite the *termination of the cord* it blends with the pia mater to form the ligamentum centrale, which passes down to the back of the coccyx, and which, in its upper part, contains the filiform prolongation of the grey matter of the cord termed the filum terminale.

N.B.—The above is not quite the present classical description of the dura mater. *See* note, p. 348c.

COVERINGS of the BRAIN & CORD—2nd Tablet.

THE ARACHNOID

Surrounds the brain & cord, from which it is separated by the sub-arachnoidean space.

Visceral Layer of the Arachnoid of the Brain — On the upper surface of the hemispheres it is thin & transparent, and passes over the convolutions without dipping into the sulci. – At the base of the brain it is thicker and slightly opaque. Crossing from side to side between the two temporo-sphenoidal lobes and between the two hemispheres of the cerebellum & the medulla oblongata, it bounds inferiorly the *anterior & posterior subarachnoidean spaces.*

It is reflected round the cranial nerves in the shape of loose sheaths as far as their point exit from the skull, where it becomes continuous with the parietal layer.

Visceral layer of the Arachnoid of the Cord — Forms, especially in the lower part, but a loose sheath round the cord & the roots of the nerves.

This sheath is single round the two roots of each spinal nerve, and is continued as far as their exit from the dura mater; the arachnoid is also reflected over the processes of the ligamentum denticulatum

THE SUBARACHNOIDEAN SPACE

Is comprised between the pia mater & the visceral layer of the arachnoid, and contains the cerebro-spinal fluid. It usually communicates with the general ventricular cavity of the brain by an opening in the layer of pia mater which bounds the fourth ventricle inferiorly.

It is narrow on the surface of the hemispheres, but is greatly expanded both at the base of the brain in the situation of the anterior & posterior subarachnoidean spaces, and also round the spinal cord.

It is crossed by numerous fibrous bands in the situation of the base of the brain and at the upper part of the back of the cord, and is partly subdivided by an incomplete membranous septum which connects the arachnoid with the pia mater opposite the posterior median fissure.

N.B.—The above is not the present classical description of the Arachnoid. *See* note, p. 348e.

COVERINGS of the BRAIN & CORD—3rd Tablet.

THE PIA MATER

On the cerebrum & cerebellum the pia mater is a delicate areolar membrane, very thin & vascular. It is thick, dense, and but slightly vascular, on the pons, the crura cerebri & the cord.

It is everywhere intimately adherent to the nervous substance; it dips down between the convolutions of the cerebrum and the laminæ of the cerebellum, and passes into the anterior and posterior median fissures of the cord; it is prolonged upon the nerves and their roots.

The pia mater of the brain penetrates into the ventricular cavities through the transverse fissure, and forms the velum interpositum and the choroid plexuses. – It usually presents an opening at the lower extremity of the fourth ventricle, by which opening the subarachnoidean space of the brain & cord communicates with the ventricular cavities of the brain.

The pia mater of the cord presents anteriorly the linea splendens, a whitish longitudinal fibrous band, and laterally, the ligamentum denticulatum. This latter descends along the whole length of the side of the cord between the anterior & the posterior roots of the nerves; its outer edge is denticulated; the denticulations, about twenty-two in number, cross the subarachnoidean space with the arachnoid reflected over them, and become attached to the dura mater in the intervals of the successive pairs of spinal nerves. The first denticulation is situated opposite the foramen magnum, between the vertebral artery & the hypoglossal nerve. — Opposite the termination of the cord the pia mater blends with the dura mater to form the ligamentum centrale, which latter passes down to the back of the coccyx, and, in its upper part, contains the filiform prolongation of the grey matter of the cord, termed the filum terminale.

* The foramen of Magendie.

FIG. 553.—THE DURA MATER WITH THE NERVES PIERCING IT, AND THE VENOUS SINUSES. (Sappey.) (*See* expl., p. 348vv.)

FIG. 554.—MEMBRANES OF THE SPINAL CORD. (Gray.)

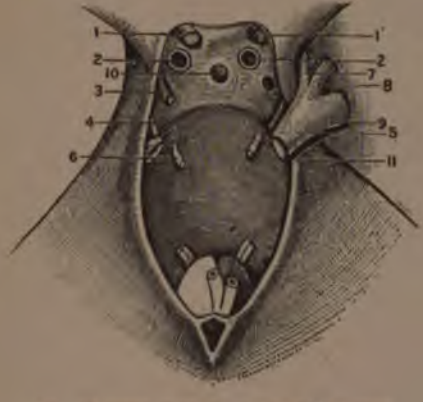


FIG. 555.—THE SUPERIOR OCCIPITAL FORAMEN. (Hirschfeld, Macalister.) (*See* expl., p. 348vv.)

FIG. 556.—SECTION OF CORD AND MEMBRANE. (Gray.)

ARTERIES of the BASE of the BRAIN.

Are the anterior & middle cerebral branches of the internal carotid and the posterior cerebral of the basilar, which are joined together by the anterior & posterior communicating.

Anterior Cerebral – Anterior & smaller of the branches of bifurcation of internal carotid opposite inner extremity of fissure of Sylvius

Forwards & inwards towards longitudinal fissure, being connected with each other by ANTERIOR COMMUNICATING, – A small branch about two lines in length.

Round genu and along upper surface of corpus callosum, and join with posterior cerebral. Give off small branches to anterior perforated space and to inner & under surfaces of frontal lobe

Middle Cerebral –The larger of the two terminal branches of internal carotid.

Forwards & outwards along fissure of Sylvius, giving twigs to anterior perforated space, and divides into branches to pia mater of frontal, parietal & temporo-sphenoidal lobes, and to central lobe or Island of Reil. – Sometimes gives off anterior choroid.

Posterior Communicating – Very variable in size.

From back part of internal carotid just before its bifurcation.

Backwards parallel to its fellow, and inosculates with posterior cerebral.

Posterior Cerebral – Two; terminal branches of basilar.

Forwards and outwards for a short distance giving numerous branches to posterior perforated space, and join posterior communicating.

Backwards & outwards on crura cerebri in front of 3rd nerve, and, curving slightly inwards, divide into numerous branches to inner, under, & outer surfaces of occipital lobe. They give off the posterior choroid.

CIRCLE OF WILLIS — Is formed in front, laterally & behind respectively by:

Anterior cerebral arteries joined by the *anterior communicating*,

Trunks of internal carotids & posterior communicating,

Posterior cerebral & basilar.

Within the circle of Willis are comprised from before backwards the lamina cinerea, optic commissure, tuber cinereum with the infundibulum, corpora albicantia & posterior perforated space

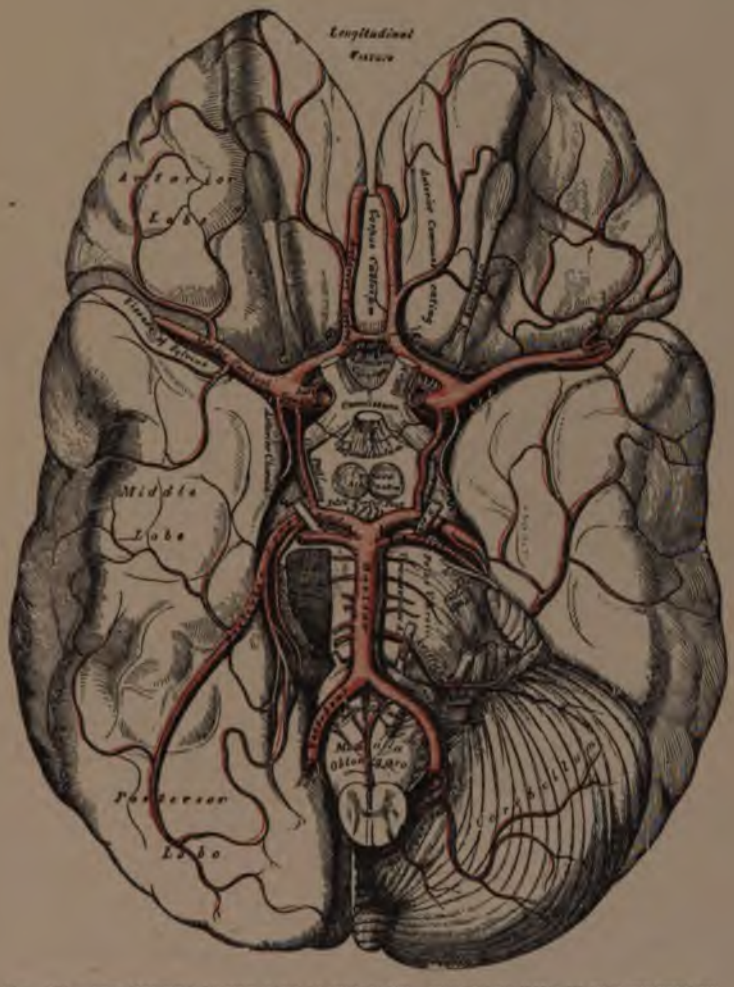


FIG. 557.—THE ARTERIES OF THE BASE OF THE BRAIN. THE RIGHT HALF OF THE CEREBELLUM AND PONS HAVE BEEN REMOVED. (Gray.)

(*See minute vascularisation of the Brain, p.* 348*g*.)

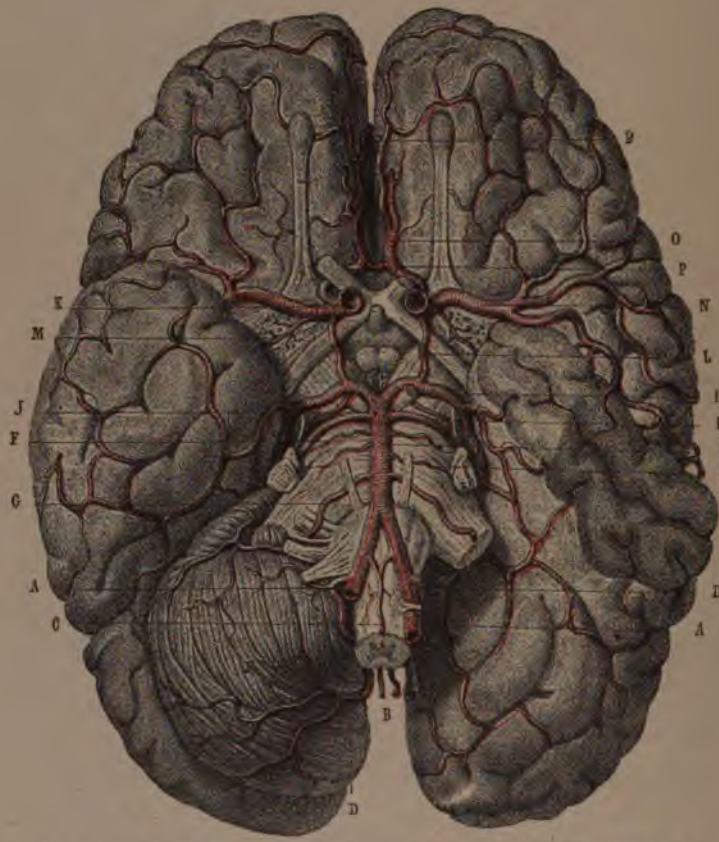


FIG. 558.—ARTERIES OF THE BASE OF THE BRAIN AS SEEN FROM BELOW. (Hirschfeld)

A, B, C, D, vertebral arteries, with their posterior and anterior spinal, and posterior inferior cerebellar branches; E, F, G, H, the basilar artery with its transverse branches (transverse arteries of the pons), and its anterior inferior cerebellar, and superior cerebellar branches; I, J, posterior cerebral artery with its posterior choroid branch; K, L, M, N, O, internal carotid artery with its posterior communicating, anterior choroid, middle, and anterior cerebral branches; P, the anterior communicating joining the latter. The figure shows the apparent origins of the 3rd, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th cranial nerves, and the anterior root of the first spinal nerve.

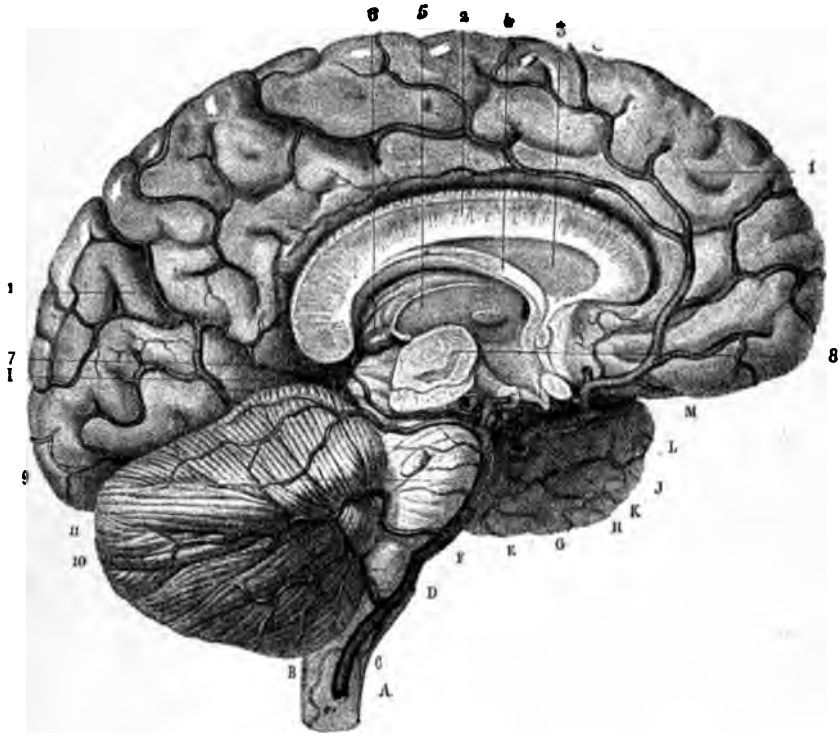


FIG. 559.—ARTERIES OF THE BASE OF THE BRAIN SEEN FROM THE SIDE. (Hirschfeld.)

A, B, C, D, right vertebral artery with its posterior and anterior spinal, and posterior inferior cerebellar branches; E, F, G, vertebral artery with its transverse branches (transverse arteries of the pons), and its anterior inferior cerebellar, and superior cerebellar branches; H, I, the divided right posterior cerebral artery and its posterior choroid branch; J, posterior communicating artery; K, L, M, left internal carotid artery with its middle and anterior cerebral branches.

1, inner surface of the hemisphere showing the ramifications of the anterior and posterior cerebral arteries; 2, corpus callosum; 3, septum lucidum; 4, fornix; 5, inner surface of the optic thalamus showing section of middle or grey commissure, and, a little in front of this, the foramen of Monro; 6, pineal gland and its peduncles, the right one being divided; 6, tubercula quadrigemina; 8, the right crus cerebri divided; 9, pons varolii showing apparent origin of 5th nerve; 10, medulla oblongata; 11, side view of cerebellum.

SINUSES of the DURA MATER.

Venous canals fifteen in number, and more or less triangular in shape, the outer coat of which is formed by the splitting of the dura mater, while their inner coat is a continuation of the inner or serous coat of the veins. They are divided into:

POSTERO-SUPERIOR GROUP: – *Superior Longitudinal, Inferior Longitudinal, Straight, Lateral, & Occipital*, all converging towards the *Torcular Herophili*

ANTERO-INFERIOR GROUP: – *Cavernous, Circular, Transverse, Superior & Inferior Petrosal*, all converging towards the sella turcica

Superior Longitudinal Sinus – Commences at foramen cæcum, through which it frequently communicates by a minute branch with veins of Schneiderian membrane of nose. Runs backwards in attached margin of falx cerebri, grooving middle line of frontal, adjacent borders of parietals & superior division of cruciał ridge of occipital, and opens into torcular Herophili. Numerous fibrous bands the *chordæ Willisii*, cross inferior angle of its cavity, and the *glandulæ* Pacchionii project into its base. It receives the superficial veins of upper part of hemispheres, numerous veins from diploë & dura mater, and, at posterior extremity of sagittal suture, the parietal veins from the pericranium

Inferior Longitudinal Sinus – Sometimes called a vein on account of its cylindrical form. Follows posterior part of free margin of falx cerebri, and opens into anterior extremity of straight sinus behind the venæ Galeni. It receives several small veins from the falx, and occasionally a few from inner surface of hemispheres.

Straight Sinus – Runs downwards & backwards in line of junction of falx cerebri with tentorium cerebelli, and opens into torcular Herophili. Receives venæ Galeni, inferior longitudinal sinus, inferior median cerebral, & superior cerebellar veins. A few fibrous bands cross its superior angle.

Occipital Sinuses – Usually two, small, contained in attached margin of falx cerebelli. Arise near posterior border of foramen magnum in several small veins which communicate with posterior longitudinal spinal veins. They pass backwards & upwards, and open separately or together into torcular Herophili.

Lateral Sinuses – Two, large. Commence at torcular Herophili; pass outwards in posterior attached margin of tentorium cerebelli as far as base of petrous portion of temporal bone, grooving occipital & posterior inferior angles of parietals; curve downwards & inwards grooving mastoid portion of temporals and again the occipital at its lateral angles; and are continued into the internal jugular vein through posterior outer or larger part of foramen lacerum posterius. – They receive the inferior cerebral & inferior cerebellar veins & some veins from the diplcë, they are connected to the cavernous sinus by the superior & inferior petrosal sinuses, and they communicate through the mastoid foramen with the mastoid & posterior condyloid veins of the pericranium. The right one is generally somewhat the larger of the two.

Torcular Herophili – An irregular expansion of the postero-superior group of sinuses pretty nearly corresponding in situation to the external occipital protuberance, and formed by the coalescence of the superior longitudinal, straight & occipital sinuses, which pour their blood into it, and of the lateral sinuses, which convey the blood from the torcular to the internal jugular veins.

Cavernous Sinuses – Two large but short sinuses, extending on either side of sella turcica from sphenoidal fissure to apex of petrous portion of temporal bone, and communicating with each other through circular & transverse sinuses, and with the lateral sinuses through the superior & inferior petrosal. Their cavity is intersected by numerous fibrous bands & small vessels; hence their name. Against their inner wall, separated from the blood by the lining membrane of the sinus, are the cavernous portion of the internal carotid artery, the 6th nerve, & the carotid & cavernous plexuses of the sympathetic; in their outer wall lie from above downwards & from within outwards the 3rd, 4th, & ophthalmic nerves. They receive the ophthalmic & anterior inferior cerebral veins.

Circular Sinus – Placed superficially in ring of dura mater which surrounds pituitary body. Receives small veins from this body, adjacent bone, & dura mater, and communicates on either side with the cavernous sinus. Its posterior half is generally larger than the anterior.

Transverse Sinus – Small & short. Crosses fore part of basilar groove, connecting cavernous & inferior petrosal sinuses of one side to those of the other; is sometimes double.

Superior Petrosal Sinus – Small, along upper border of petrous portion of temporal bone in anterior attached margin of tentorium, connecting lateral & cavernous sinuses of same side. Receives inferior cerebellar & inferior lateral cerebral veins.

Inferior Petrosal Sinus – Somewhat larger than foregoing. Along groove in petro-occipital suture, connecting cavernous sinus to termination of the lateral in jugular foramen.

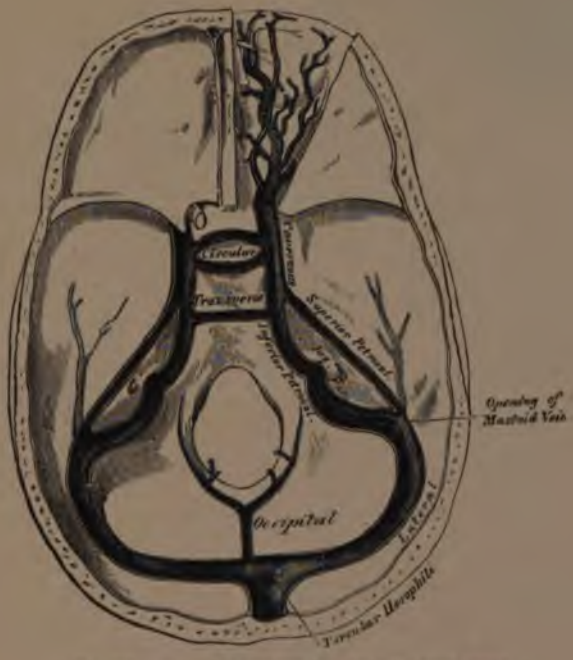


FIG. 360.—SINUSES OF THE DURA MATER, SEEN FROM ABOVE.

FIG. 361.—SINUSES OF THE DURA MATER, SIDE VIEW.

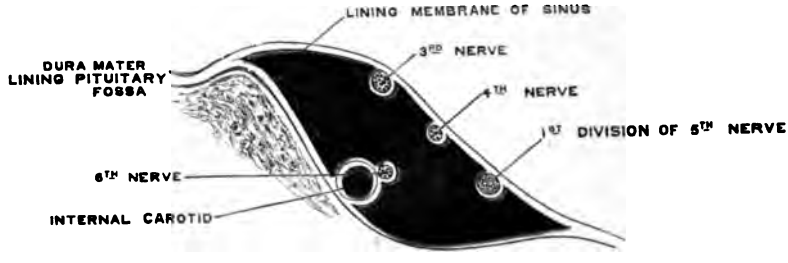


FIG. 562.—PLAN OF RELATIVE POSITION OF STRUCTURES IN RIGHT CAVERNOUS SINUS, LOOKED AT FROM BEHIND. (Gray.)

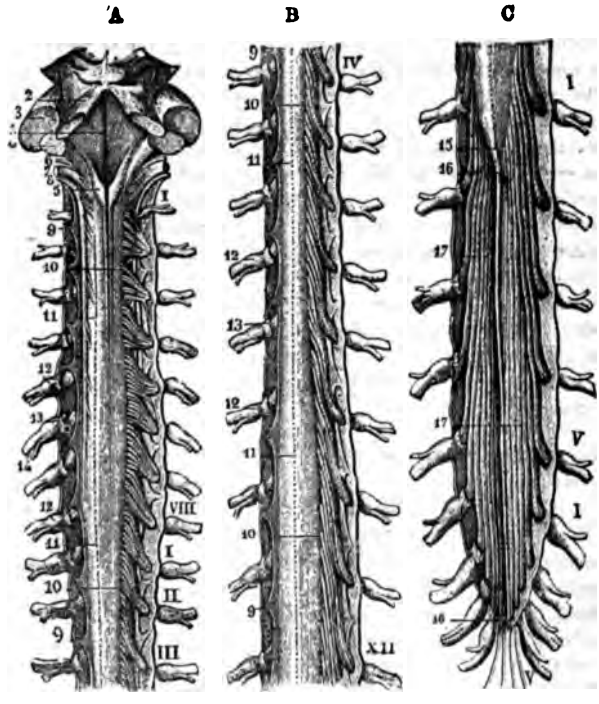


FIG. 563.—VIEW FROM BEHIND OF THE MEDULLA OBLONGATA AND SPINAL CORD, WITH THE THECA. (Hirschfeld, Sappey, Quain.)

The dura-matral sheath has been opened by a median incision and is stretched to either side. In the upper and middle parts, A and B, the posterior nerve-roots have been removed on the left side to show the ligamentum denticulatum. 1, floor of fourth ventricle; 2, 3, 4, cerebellar peduncles; 5, clavus; 6, 7, 8, roots of glosso-pharyngeal, vagus, and spinal accessory nerves; 9, one of the processes of the ligamentum denticulatum; 10, 11 (in A), line of entrance of the posterior roots of the nerves, or postero-lateral fissure; 11 (in B), postero-median fissure; 12, ganglia; 13, anterior roots; 14, spinal nerve-trunk dividing into its anterior and posterior divisions; 15, 16, filum terminale; 17, cauda equina.

THE SPINAL CORD.

The *spinal cord* is about 18 inches long, and extends from the foramen magnum to the lower part of the body of the first lumbar vertebra, or upper part of the second. Above, it is continued into the medulla oblongata; below, it tapers to a point (conus medullaris), and ends in a slender filament, the *filum terminale*, or *ligamentum centrale*.

The exact position of the lower end of the cord varies somewhat according to the curvature of the vertebral column; in marked flexion the end of the cord is slightly raised. In the fœtus, at an early period, the cord occupies the whole length of the vertebral

canal; but, after the third month, the canal and the roots of the lumbar and sacral nerves grow more rapidly than the cord itself, so that at birth the lower end of the cord reaches only to about the third lumbar vertebra.

The cord is enclosed in a sheath (*theca*) considerably longer and larger than itself, formed by the dura mater, and separated from the walls of the vertebral canal by venous plexuses, and a good deal of loose areolar tissue. The cavity of the sheath is divided by the curtain-like arachnoid into the subdural and subarachnoid spaces, the latter occupied by cerebro-spinal fluid. Within the latter space the cord is kept in position by the ligamentum denticulatum, and by the roots of the spinal nerves which pass across the space from the surface of the cord towards the intervertebral foramina.

In section the cord is nearly circular, especially in the thoracic region, though somewhat flattened in front and behind. The cord is not, however, of uniform diameter throughout, but presents two enlargements – an upper or cervical (brachial), and a lower or lumbar (crural). The cervical enlargement is of greater size and extent than the lumbar. It extends from the upper limit of the cord to the body of the first or second thoracic vertebra, and is largest opposite the fifth or sixth cervical vertebra. The lumbar enlargement begins at the tenth thoracic vertebra, and is largest opposite the twelfth; its antero-posterior diameter is more nearly equal to the transverse than is the case in the cervical enlargement.

Fissures.—The cord is partially divided into right and left halves by anterior and posterior median fissures, which penetrate the greater part of its thickness. The *antero-median fissure* is the wider, but shallower, of the two, and contains a distinct fold of pia mater. It is bounded anteriorly by the anterior or white commissure. The postero-median fissure is much narrower, but penetrates to the centre of the cord; it contains but a thin process of connective tissue and blood-vessels prolonged into it from the pia mater. It is bounded anteriorly by the posterior or grey commissure.

A well-marked furrow, the *postero-lateral fissure*, is seen on each side of the cord, corresponding to the line of emergence of the posterior roots of the spinal nerves. This divides each lateral half of the cord into anterior and posterior portions, of which the former is again divided into two by the line of attachment of the anterior roots. The cord thus comes to be parted into three columns, anterior, middle, and posterior.

In the cervical region a slightly marked longitudinal groove, the *postero-intermediate furrow*, runs on the surface of the posterior column near to the postero-median fissure. It indicates the position of a delicate septum of connective tissue passing from the pia mater into the posterior column, and dividing the latter into a *postero-median column*, or column of *Goll*, and a *postero-lateral column*, or column of *Burdach*.

White Matter.—The white matter increases in amount from below upwards. It completely surrounds the grey matter, except opposite the posterior commissure and opposite the apex of the posterior cornu referred to below.

Grey Matter.—The grey matter forms a fluted column. In transverse section, it is in the shape of the letter H. On each side there is a crescentic mass shaped somewhat like a comma with its concavity outwards, and the convexity of which is joined to the convexity of the opposite side by the posterior or grey commissure. This latter contains the central canal of the cord.

Each crescentic mass is divided into anterior and posterior cornua. The *anterior cornu* is short and thick, but fails to reach the surface of the cord. Its anterior enlarged extremity is the *caput cornu*; the constricted part near the grey commissure is the *cervix*

FIGS. 564 & 565.—THE SPINAL CORD AND ITS RELATIONS AS SEEN FROM IN FRONT AND FROM BEHIND. (Hirschfeld.)
(*See expl.*, p. 348VV.)

cornu. The *posterior cornu* is long, narrow, and pointed, its extremity, or *apex cornu*, nearly reaching the bottom of the postero-lateral fissure. The slightly enlarged portion following this is the caput, and the succeeding constricted part is the cervix. Capping the apex cornu is a slightly modified semi-transparent grey matter, the *substantia gelatinosa of Rolando*. In the thoracic region, especially in its upper part, there projects from the concavity of the crescent, nearly opposite the grey commissure, the *lateral cornu*, or intermediate process of Gowers. Above, in the cervical region, and below, in the lumbar region, this blends with the anterior cornu, – to reappear, however, in the sacral region. The amount of the grey matter is everywhere proportionate to the size of the nerve-roots given off. It is greatest in the cervical and lumbar enlargements.

Spinal Nerves.—These are thirty-one in number on each side, eight cervical – counting the sub-occipital nerve – twelve dorsal, five lumbar, five sacral, one coccygeal. These nerves split up into their anterior and posterior divisions immediately beyond the root-ganglion below referred to.

Nerve-Roots.—For each nerve these are two in number, anterior and posterior. The latter, except in the case of the sub-occipital nerve, is the larger of the two. It is marked by the large oval root-ganglion, situated just internal to where the two roots unite to form the spinal nerve-trunk.

The lower lumbar and upper sacral nerve-roots are by far the largest; but the sequence rapidly falls in regard to size, the two lower sacral and coccygeal roots being the smallest of all. The cervical nerve-roots are quite small to begin with, but they rapidly increase in size from above downwards. The roots of the first thoracic nerve are large; those which succeed them are relatively small and uniform in size.

The upper cervical nerve-roots are short and horizontal; but length and obliquity increase from above downwards. The lower dorsal, lumbar, sacral, and coccygeal nerve-roots descend almost vertically for a considerable distance, forming the well-known bundle termed the cauda equina.

Except in the case of the two upper cervical, and of the sacral and coccygeal nerves, the root-ganglia lie in the intervertebral foramina just externally to the point where the anterior and posterior roots perforate the dura mater. The two upper cervical ganglia lie on the posterior arch of the atlas and the laminæ of the axis respectively. The sacral and coccygeal ganglia lie in the sacral canal, the coccygeal ganglion occupying about the mid-point of the corresponding root.

Filum Terminale.—The filum terminale lies in the midst of the long lower nerve-roots, from which it is distinguished by its glistening appearance, and from its being attached to the apex of the medullary cone. Opposite the second or third sacral vertebra it pierces the tapering tube of dura mater, receiving an investment from it; it ends by blending with the periosteum on the back of the coccyx or last piece of the sacrum. The central canal of the cord is prolonged into it for about half its length. Nervous elements can be traced down to this point. Below this there is only connective tissue found.

NOTES ON THE NEWER MATTER:—

I.—Coverings of the Brain and Cord, p. 348c.

II.—Cerebral Surface, p. 348i.

III.—Interior of the Brain, p. 348s.

IV.—Minute Vascularisation, p. 348y.

V.—Cranio-Cerebral Topography, p. 348cc.

VI.—Medulla Oblongata and Mesocephalon (transverse sections), p. 348hh.

VII.—Development of the Brain, p. 348rr.

I.

COVERINGS OF THE BRAIN AND CORD.

DURA MATER. – A note to page 384.

Is imperfectly divided by blood vessels and lacunar spaces into two layers, *endosteal*, and *meningeal* or supporting.

The *endosteal layer* contains the vessels which nourish the cranial bones. Its outer surface is partly smooth and lined with the epidural endothelium bounding the subendosteal lymph spaces, and partly rough and closely adherent, specially to the sutures of the base of the skull and to the edges of the foramina, where it becomes continuous with the external pericranium. At the foramen magnum the endosteal layer is continued into the vertebral periosteum, and the meningeal layer into the dura mater of the cord; between the two there is a wide space containing fat, connective tissue, and a plexus of veins, the homologue, not of the epidural, but of the interdural lymph spaces within the cranium.

It is the *meningeal* layer that forms the falx cerebri, the tentorium and falx cerebelli, and the diaphragma sellæ. The diaphragma sellæ is a small circular fold, which constitutes a roof for the sella turcica. It almost completely encases the pituitary body, presenting but a small central opening for the passage of the infundibulum.

Sinuses of the Dura Mater.

These vessels differ considerably in character.

Some are fairly tubular and lined by a continuous layer of endothelium, – though even in these the blood stream is broken up by a number of fine filaments, the chordæ Willisii, which are most numerous at the point of separation of the endosteal and meningeal layers, – *e.g.*, lower part of the superior longitudinal sinus, and upper part of the straight sinus. Other channels are little more than irregular cavernous spaces grouped together in the largest areæ of separation of the endosteal and meningeal layers of the dura mater, that is over the basilar groove, at the back and sides of the basi-sphenoid, the apex of the petrous bone, the root of the ali-sphenoid, and the floor of the sella turcica. The inner wall of even the cavernous sinus scarcely exists as a distinct lamella, though the internal carotid artery, the sixth nerve, and the cavernous plexus of the sympathetic lie internal to the principal part of the space, and form part, so to speak, of its inner boundary.

Torcular Herophili.

The mode of union of the superior longitudinal, lateral, and straight sinuses is somewhat variable. As a rule, the superior longitudinal sinus turns to the right, and opens into the right laternal sinus, while the straight sinus turns to the left, and opens into the left lateral sinus. It is exceptional to find the four vessels exactly symmetrical.

The lateral sinus in continuation with the superior longitudinal sinus (usually the right one), is generally larger than the other.

In the fœtus the *superior longitudinal sinus* is continuous with the nasal veins through the foramen cœcum. In the adult it merely begins in the dura mater in front of the crista galli.

The *superior petrosal sinus*, as it runs backwards and outwards from the cavernous sinus, arches over Meckel's space and the contained fifth nerve, grooves the upper border of the petrous bone, and opens into the confluens lateralis, or point of junction of the lateral and sigmoid sinuses and the mastoid vein.

The *inferior petrosal sinus* pierces the dura mater in front of the ninth and tenth nerves, passes to the inner side of these, and opens into the internal jugular vein as it lies in the jugular fossa.

Lateral and Sigmoid Sinuses, and Confluens Lateralis.

The two sinuses above named form together what is described in adult anatomy under the name of "*lateral sinus.*" The point of junction of the two sinuses is at the *confluens lateralis*, which lies opposite the posterior inferior angle of the parietal bone where both the superior petrosal sinus and the mastoid vein open into the confluent.

The *mastoid vein* was originally a large channel connecting the conjoined sinuses to the true external jugular vein, which latter vein, and not the internal jugular, formed in the embryo the continuation of the lateral sinus into the soft parts of the neck. The sigmoid sinus, at first but a small channel of communication between the lateral sinus and foramen lacerum posterius, dilated as the mastoid vein diminished in size, and it is thus that it came to continue the lateral sinus into the *internal* jugular vein.

The sigmoid sinus communicates near its termination with the corresponding occipital sinuses, or with the occipital sinus if there is but one, by means of a small *marginal vein*, which runs along the posterior border of the foramen magnum. This vein frequently forms a communication between the occipital sinus, or sinuses, and the veins of the spinal cord.

In addition to the mastoid vein above referred to, a second emissary vein, the posterior condyloid vein, passing through the posterior condyloid foramen, connects the sigmoid sinus with the veins of the scalp. These emissary veins allow of a certain overflow of the blood of the sinuses in cases of over-distention.

Spheno-parietal Sinus.

This is a small channel running inwards under shelter of the lesser wing of the sphenoid, and which opens into the front part of the cavernous sinus. Externally it commences in one of the small meningeal veins.

The *transverse*, or *basilar*, sinus is rather a plexus of sinuses stretching somewhat variably over the basilar groove, than a well-defined and single transverse channel.

The *circular sinus*, joining the cavernous sinuses of either side in front of and behind the pituitary body, is now divided by some anatomists into the *anterior* and *posterior inter-cavernous sinuses.*

The *paramesial sinuses* or *lacunæ laterales* are irregular sinoidal recesses, greatly varying in size and number, which may be ranged, along the sides of the superior longitudinal sinus; on the one hand they receive some small meningeal or diploic veins,

and, on the other, they open into the longitudinal sinus either by a small aperture or by a narrow channel. Some attention has been called to them in connection with the Pacchionian bodies below referred to.

Jugular Veins.

It is incorrect, embryologically, to describe the *external jugular vein* as formed by the junction of the temporal and internal maxillary veins. The trunk thus formed is merely a *communicating branch* which opens into the *true external jugular vein* on the surface of the sterno-mastoid. This *true external jugular vein* is formed higher up by the junction of the occipital and posterior auricular veins over the posterior border of the mastoid process. This latter vein varies considerably in the adult, for the reason that it is merely a degenerated remnant of the vein which, as above explained, originally drained the blood from the lateral and superior petrosal sinuses through the confluens lateralis, – the vestiges of which arrangement are occasionally preserved in the persistent mastoid vein of the adult. When the communicating branch above referred to is described as the upper part of the external jugular vein, as is customary in descriptive anatomy, the term "*posterior external jugular*" is applied to what is the upper part of the true external jugular vein. (Macalister.)

The *internal jugular vein* ends at the upper border of the thyroid cartilage, where it is joined by the temporo-facial trunk, and becomes the *common jugular*. (Macalister.)

Pituitary Body.

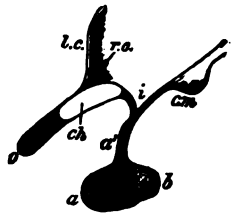


FIG. 566.—SAGITTAL SECTION THROUGH PITUITARY BODY AND NEIGHBOURING PARTS.

a., anterior lobe; *a'*, projection from it towards front of infundibulum; *b*, posterior lobe connected by a solid process with infundibulum; *l.c.*, lamina cinerea; *o*, right optic nerve; *ch*, section of chiasma; *r.a.*, recess of third ventricle above chiasma; *c.m.*, corpus mammilare. (Quain.)

It is the smaller posterior lobe of the pituitary body, developed, as explained page 348ss, as an outgrowth of the thalamencephalon, that the infundibulum connects with the tuber cinereum. Even in the adult this lobe is distinct from the larger anterior lobe of pharyngeal origin, which surrounds it except behind. The pituitary body as a whole is oval in shape, slightly flattened from above downwards, and with its long axis transverse. It may easily be removed from the sella turcica by notching the diaphragma sellæ.

ARACHNOID. – A note to page 335.

It is a satisfaction to the Author to have reinstated the Tablet on the arachnoid as it originally stood, and thus once more to have presented this membrane – in company with every anatomist (human anatomist),* and every surgeon, from the days of Bichat up to about fifteen years ago – as, to his mind, it should ever have been presented, specially to medical men, namely, as a serous membrane, – a closed sac (macroscopically) with parietal and visceral layers, continuous, and everywhere lined with endothelium. His having dropped

* See foot-note on p. 348f.

the above description – though in company with respected leaders – was a concession to the "advanced" School, which he has ever since regretted. Words must lose their meaning before the said description can be at all seriously impugned from the *dissectional* point of view *

The reasons the scientists have given for opposing the once universally accepted description are as follows: (1), that it is impossible – the Author reads it, not easy – to make out a distinct layer of connective tissue – distinct, that is, from the dura mater – supporting the external or parietal layer of endothelial cells; and (2), that the arachnoid has an origin different from that of the peritoneum, pleura, &c.

But what tissue distinctly separable from the lung tissue intervenes between the lung and the pulmonary pleura? And does the point, after all, affect the question? If a simple layer of epithelium is good enough to make up the roof of the third ventricle, why not, even if unsupported, to form the outer wall of a serous sac?

As to the second reason, it is brushed away by the very facts set forth by Prof. Macalister, who is both philosophical and perfectly candid in the matter. Prof. Macalister explains admirably, as indeed is quite evident, how: (1), between parts that move upon each other, connective tissue becomes laminated, with flattened cells on its surface; and, where there is much gliding, condensed and membranous, and overlaid with a continuous layer of endothelial cells; (2), that when, at an early period, the mesoblast (ventral mesoblast) splits into the splanchnopleure and somatopleure bounding the cœlom, the tissue lining this cavity becomes transformed, as above, into a serous membrane, which is subsequently segmented – though the point has nothing to do with the argument – into pleura, pericardium, peritoneum, and tunica vaginalis.

Now exactly the same changes take place in connection with the dorsal mesoblast. It is this dorsal mesoblast which, rising up between the layers of the dorsal epiblast, forms the membranes of the brain and cord. This dorsal mesoblast must therefore split up just as does the ventral mesoblast. Where, then, is the difference, even embryologically, between the ventral and the dorsal gliding arrangements? If the splitting of the ventral mesoblast gives rise to a serous membrane, why refuse the name to the quite similar structure resulting from the splitting of the dorsal mesoblast? †

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* The arachnoid was described as a serous membrane by every one of our dissectional anatomists – Wilson, Gray, Ellis, Heath, and Holden. In the view of Hirschfeld, undoubtedly the greatest dissectional authority on the nervous system that we have known, there is nôt a shadow of a doubt in regard to the matter, or even a shadow of a suspicion that any doubt could arise. But let the dissector just remove the skull-cap, and look, and see for himself: Such is the way to learn human Anatomy.

In lieu of the suppressed – now indeed condemned – term, "serous membrane," one now finds in books such evasive descriptions as "an intermediate structure," "a thin membrane," "a delicate membrane," "a fibrous membrane" – which latterly is certainly incorrect – or the truism, "a membrane which is seen when the brain is removed (?) from its cavity." When were membranes of any kind classified into thick and thin, stout and delicate, or into "intermediate" and whatever the converse of that term may be or defined as such as may be seen when such and such a structure has been removed?

† We are everywhere witnessing, now-a-days, on the one hand, the exaltation of imaginary distinctions, and, on the other hand, the whittling down of real differences till distinctions important to the surgeon are lost sight of: "A layer of flattened endothelial cells covers the inner surface" of the dura mater, "*and also its outer surface between the places of adherence to the bones and sutures.*" And where the two layers of the dura mater split (at the foramen magnum) to form, on the one hand, the dura mater of the cord, and on the other, the periosteum of the spinal canal, "*a similar layer of cells covers* BOTH *surfaces*" of the former. Here is a distinct assimilation of the sub- and epi-dural spaces. Again:— Both surfaces of the inner or entima layer of the pia mater are bounded by a "*lymph space.*" And on the nerves leaving the brain and cord, they receive "*lymph-sheaths* from the dura mater, the pia mater, and the arachnoid, which may be injected from the subdural and arachnoid spaces as far as the limbs." The Author has no hesitation in saying that this is absolutely untrue in naked-eye anatomy. It is this basing anatomy (so-called) on "transcendental" generalisations that is leading to the present sacrifice of most important naked-eye truth. It is certainly not the kind of anatomy wanted by medical men that has led to the temporary abandonment of the description of the arachnoid as a serous membrane.

Descending to histological ground, the parallel becomes still more complete. The arachnoid is as much a large lymph-space as the peritoneum, and apparently not without its stomata similar to those which are found on the under surface of the diaphragm.*

It is when the parietal layer of the arachnoid is ignored, that the "cavity of arachnoid" becomes the "subdural space."

The Subarachnoid Space.

The subarachnoid space is broken up by filaments and trabeculæ forming an extremely delicate meshwork. Over the summit of the convolutions these are short, and the meshwork close; and the arachnoid and pia mater are difficult to separate. The reverse pertains between the convolutions. It is here that the larger arteries and veins ramify in the subarachnoid space, their walls being bathed in the subarachnoid fluid, and supported by the trabeculæ.

Cisternæ Subarachnoidales.

These are local expansions of the general subarachnoidean space. There are two principal ones, which have long been known as posterior (cisterna magna) and anterior (cisterna basilaris), with which are connected the cisterna pontis, and other smaller expansions.

The *cisterna magna* is formed by the arachnoid bridging over the interval between the hemispheres of the cerebellum and the back part of the medulla. It is the direct continuation of the back part of the subarachnoidean space of the cord.

The *cisterna basilaris* corresponds to the basilar groove, and to circle of Willis and the interpeduncular space of the base of the brain. Here the arachnoid, leaving the cerebral surface, passes across from one temporal lobe to the other, bridging over the hollow in this situation. Two lateral channels pass out from this, accompanying the middle cerebral arteries into the Sylvian fissures. Anterior prolongations similarly communicate with an expansion in front of the optic chiasma, and from this latter a small channel is said by some to be prolonged round the anterior cerebral arteries as they pass over the upper surface of the corpus callosum.

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* In connection with the contention submitted, the above argument might even be quite incorrect for what the Author *need* care, - though competent friends have failed to detect the flaw, - and yet the Author would have to maintain exactly the same ground on the simple basis of Dissectional Anatomy, whose teachings are clear on the point raised. Dissectional Anatomy, the Author maintains, is to be looked upon as a science in itself, independent of, and altogether superior to, the fascinating niceties of the scientist. It is the form of anatomy which serves directly the objects of the medical man. It is the only form of anatomy which has a medical history at its back, - and a history of noble self-sacrifice, and of worthy service rendered. Alone, to the Author's mind, it constitutes Anatomy in the professional sense.

The Author is far from unsupported in this matter. The best of the profession are with him :—

> "I regret to find that the teaching of anatomy is gradually getting more and more into the hands of professors who are anatomists but not surgeons, and that their tendency is to lay stress upon transcendental details rather than surgical relations."—(Christopher Heath.
>
> "We may be training a school of more or less scientific anatomists, but we are not insisting on such curriculum of study, and on such examinations, as will produce in the future *well-grounded, thoroughly practical,* and *efficient medical men.* . . . Those scientific anatomists who concern themselves with other vertebrates, and who, apparently, treat of an ideal evolutionised human body of their own creation, have *no experience of the requirements* of *those who are destined to medical practice.*"—*The Lancet.* (The italics are the Author's.)

Posteriorly the cisterna basilaris is joined to the cisterna pontis, which lies in front of the medulla and pons, and which is the continuation upwards of the anterior subarachnoid space of the cord. The cisterna pontis is joined to the cisterna magna.*

The subarachnoidean space of the cord is divided into three more or less distinct compartments by the ligamenta denticulata and the mesial septum posticum. The latter is tolerably complete opposite the lower part of the cord, where the subarachnoid space is most expanded, but superiorly it consists of little more than a few separately superposed strands. The ligamenta denticulata present a continuous inner attachment to the pia mater. Their outer margin offers some twenty-two denticulations, which are attached to the dura mater about midway between the points of exit of the several pairs of cranial nerves.

The two posterior compartments of the subarachnoid space of the cord are continued upwards into the cisterna magna; and the anterior compartment into the cisterna pontis and the cisterna basilaris.

The subarachnoid space communicates with the fourth ventricle – and through this with the ventricular cavities of the brain – through the foramen of Magendie, and the foramina of Key and Retzius. A communication is said to exist between the cisterna basilaris and the descending cornu of the lateral ventricle.

Pacchionian Bodies.

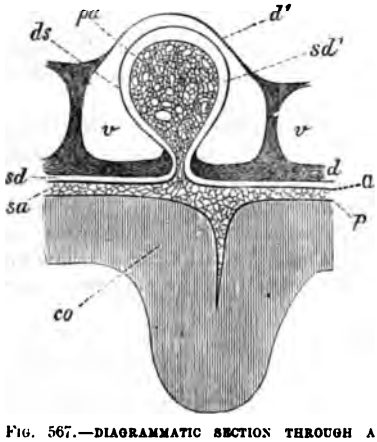

FIG. 567.—DIAGRAMMATIC SECTION THROUGH A PACCHIONIAN BODY, OR ARACHNOID VILLUS (Schwalbe.)

pa, arachnoid villus; *d*, *d'*, *ds*, deep and superficial layers of dura mater, both reduced to a thin lamina over the villus; *sd*, *sd'*, subdural space, and its prolongation round the villus; *a*, *sa*, arachnoid and subarachnoid tissue, a prolongation of the latter forming the villus; *p*, *co*, pia mater and convolution.

These are small granular bodies often seen on either side of the superior longitudinal sinus, especially over in the hinder part of the parietal region, most numerous as age advances, and which frequently give rise, by absorption, to small pits on the inner table of the skull, in which they then lodge. They are hypertrophied villi of the arachnoid. Their penetration of the dura mater, and, as above mentioned, of the inner table of the skull, is interesting. They do not actually pierce the dura mater; they always carry before them an attenuated covering derived from that membrane. It is thus that they often appear to project into the superior longitudinal sinus, while really excluded from the same. They may similarly project, or appear to project, into the paramesial sinuses. Each villus is made up of subarachnoidean trabecular tissue, and is covered by a continuation of the arachnoid. Outside this is a thin sheath derived from the dura mater, and in the interval between the two is a continuation of the subdural space.

* Is it not following the lymph-space transcendentalism of Key and Retzius too far to refer, as some authors do, not only to some half-dozen more "cisternæ subarachnoidales" (cisternæ pontis mediæ, pontis lateralis, interpeduncularis, chiasmatis, laminæ cinereæ, fossæ Sylvii, &c.), but to further refer to the "flumina," "rivi," "rivuli," which these are taken to receive from the supposed clefts following the greater and the secondary & tertiary cerebral fissures? This is certainly not the kind of anatomy wanted by medical men.

II.

THE CEREBRAL HEMISPHERES.

(These Notes should read in conjunction with the pages they are respectively stated to refer to.)

FISSURES ON THE CONVEX SURFACE.—A Note to page 280.

The *fissure of Rolando*, or *central sulcus* (R, Fig. 568), begins either close to, or upon, the supero-mesial border of the hemisphere, – and when indenting the supero-mesial border, it usually sends a slight backward prolongation into the paracentral lobule on the inner surface of the hemisphere (R, Fig. 572). It is often somewhat sinuous, presenting two slight bends, or *genua*, the superior one with concavity forwards, the inferior one inversely disposed. It sometimes joins with the fissure of Sylvius.

Beginning in the *vallecula Sylvii* at the outer part of the anterior perforated space, the *stem*, or undivided part, of the *fissure of Sylvius* passes outwards between the temporal pole and the orbital surface of the frontal lobe, and divides into the already mentioned posterior limb, and two shorter limbs, anterior and ascending. The *anterior limb* (S^2) runs parallel to the superciliary margin of the hemisphere, separating the orbital and triangular portions (3 & 2) of the inferior frontal convolution; the *ascending limb* (S^3) passes vertically upwards, separating the triangular and basilar portions of the same (2 & 1). (*See* Fig. 568.)

The division of fissures into *complete*, – that is, involving the whole thickness of the cerebral wall and appearing on the inner surface of the same, – and *incomplete*, or mere surface furrows, scarcely touches the question of cerebral topography. The complete fissures – three in number, the *dentate* or *hippocampal*, the *collateral*, and the *calcarine* (anterior portion only), all lie on the inner surface of the hemisphere, and only one of these, the calcarine, is interlobar in character. The fissure of Sylvius is sometimes described as a complete fissure, since it is seen to correspond embryologically to the corpus striatum; but the corpus striatum is formed, not as an infolding of the mantle wall, but as a thickening of the floor of the prosencephalon. (*See* Development of the Fissure of Sylvius, p. 348tt.)

(The calloso-marginal fissure may be taken as an interlobar fissure in connection with the delimitation of the limbic lobe.)

FRONTAL LOBE.—A Note to page 282.

The *precentral sulcus* is often divided into two portions, the *superior* (4) and *inferior* (5) *precentral sulci*, the latter occasionally presenting a short horizontal offshoot, and then being more or less F- or T-shaped.

The superior and middle frontal convolutions are not unfrequently divided, each into two lateral halves, the frontal lobe then presenting *five* superposed tiers (Cunningham), instead of three. Thus the inner half of the *superior frontal convolution* may be separated from the outer half by a series of short and irregular furrows (sulcus paramedialis) running parallel to the longitudinal fissure, – these furrows being of interest through their being found only in the higher types of brains. The *middle frontal convolution*, which is broader than the two others, may be similarly subdivided anteriorly by the *middle frontal sulcus* of Ebersteller.

The *inferior frontal convolution* is of particular interest through its containing the speech-centre of Broca. It is subdivided, from behind forwards, into pars basilaris (1), pars triangularis (2), and pars orbitalis (3), by the ascending and anterior limbs of the fissure of Sylvius. The *pars basilaris* lies behind the ascending limb of the fissure (S^3); the *pars triangularis* lies between this limb and the anterior limb (S^2); the *pars orbitalis* lies below the anterior limb, and reaches to the superciliary margin of the hemisphere.

The left inferior frontal convolution is usually larger than the right one, in harmony with the special location of the speech-centre on that side. The increased development chiefly affects the pars triangularis, which, when well developed, may push its way between, and entirely separate, the anterior and ascending limbs of the fissure of Sylvius.

PARIETAL LOBE.—A Note to page 282.

The parietal lobe presents a number of important and interesting fissures well worthy of careful study. These are:

1. – *Horizontal* (8), and *superior* (9) and *inferior* (10) *post-central fissures*, which are more or less joined together to form the intraparietal fissure of Turner.
2. – The *upturned ends* of the *fissure of Sylvius* (S^1), of the *parallel or superior temporal fissure* (11), and of the *middle temporal fissure* (12); these supply the basis of Prof. Cunningham's description of the inferior parietal convolution, given below. To these may be added
3. – The *ramus occipitalis* (13), which belongs also to the occipital lobe.

The *superior post-central fissure* (9) lies behind the upper half of the fissure of Rolando; the *inferior post-central fissure* (10) lies behind the lower half of the same; these two fissures are frequently confluent. The *ramus horizontalis* (8) extends backwards from the upper end of the inferior post-central fissure, and separates the superior and inferior parietal convolutions.

The upturned ends of the fissure of Sylvius, of the parallel or superior temporal fissure (11), and of the inferior temporal fissure (12), are of importance as marking the *three* subdivisions of the inferior parietal convolution as given by Prof. Cunningham. These subdivisions are:

a. – *Supra-marginal convolution*, which arches over the upturned end of the fissure of Sylvius, and is continuous below & behind with the superior temporal convolution;

b. – *Angular convolution*, which arches over the upturned end of the parallel or first temporal fissure, and is continuous below and behind with the middle temporal convolution;

c. – *Post-parietal convolution*, which arches over the upturned end of the second temporal fissure, and is continuous below & behind with the inferior temporal convolution.

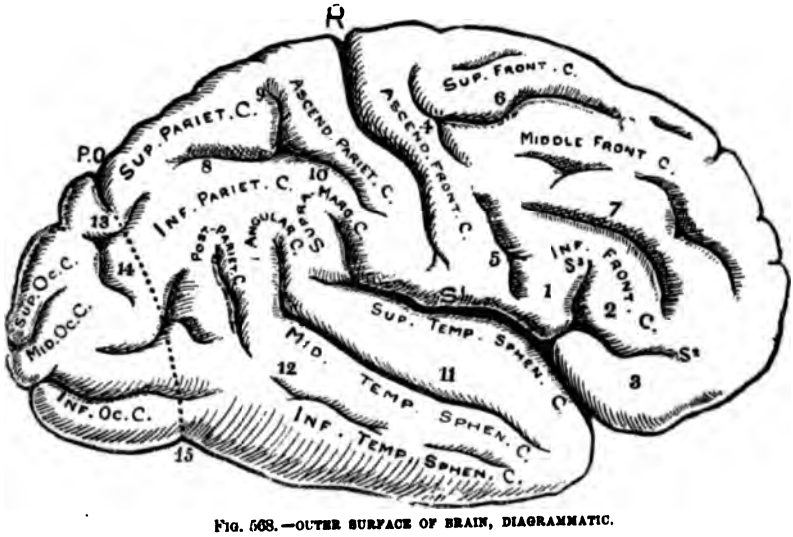

FIG. 568.—OUTER SURFACE OF BRAIN, DIAGRAMMATIC.

TEMPORAL LOBE.—A Note to page 286.

The superior temporal fissure, or *parallel fissure* (11), is always well marked. As above stated, its posterior extremity turns upwards into the parietal lobe, and is arched over by the angular convolution, which is built up upon it. The *inferior temporal fissure* (12) is often broken up into several pieces. Its posterior extremity likewise turns upwards into the parietal lobe, and is arched over by the post-parietal convolution.

OCCIPITAL LOBE.—A Note to page 286.

The *ramus occipitalis* of Turner's intra-parietal fissure (13) extends posteriorly, as already stated, into the occipital lobe; in its backward course it embraces the lower extremity of the external parieto-occipital fissure (P.O.), bounding what is sometimes called the arcus parieto-occipitalis. In the occipital lobe proper it bifurcates to form the *transverse occipital fissure* (14).

The boundary between the occipital, and the parietal & temporal lobes is clearly marked off, in the upper part only, by the short external parieto-occipital fissure. Lower down it may be demarcated for a short distance by the upturned end of the inferior temporal fissure. Short of this, an arbitrary line of demarcation (dotted in the figure) is often drawn between the external parieto-occipital fissure and the pre-occipital notch (15) on the inferior lateral border of the hemisphere. The above-mentioned *transverse occipital fissure* is sometimes taken as marking the boundary, this fissure then being called the *anterior occipital fissure.*

The description of the outer surface of the occipital lobe given in the Tablet, though agreeing with Prof. Macalister's description, is not now taken as representing the usual condition of that lobe. The sulci on the occipital lobe "are not constant enough in position and direction to serve for marking out its surface into distinct gyri. If a division must be made, it should be into anterior & posterior gyri situated, respectively, behind a small *lateral* occipital fissure (*see* Fig. 571), and between this fissure and the *anterior* occipital fissure above referred to."—(Quain.)

CENTRAL LOBE, or ISLAND OF REIL.—A Note to page 286.

The *central lobe* is somewhat triangular, with apex below and in front, *i.e.*, at the vallecula Sylvii. It is divided into a *precentral*, or frontal portion, and a *post-central*, or limbic portion, by a fissure somewhat deeper and of earlier formation than the others, the *sulcus centralis insulæ.*

This lobe is interesting morphologically. It is developed very early in connection with the corpus striatum, to which it remains adherent; it is thus precluded from keeping pace with the general expansion of the hemisphere, and soon becomes covered in by the surrounding convolutions,—the four *opercula.** It is covered in above and in front by the frontal and parietal lobes, which form three of the four opercula, namely:

Orbital – formed by the pars orbitalis of the inferior frontal convolution;
Frontal – formed by the pars basilaris of the same;
Fronto-parietal – formed by the ascending frontal & ascending parietal convolutions;

and covered in below by the temporal lobe, which forms the *temporal* operculum.

The central lobe is surrounded by a continuous sulcus, the *sulcus limitans*, or *sinus circularis Reilei*, which is divisible into anterior, external, and posterior portions.

* For this reason it is not inappropriately termed by German writers (with the basal ganglia and the crura cerebri) the *stem* of the hemisphere, the remainder of the cerebrum being collectively termed the *mantle.*

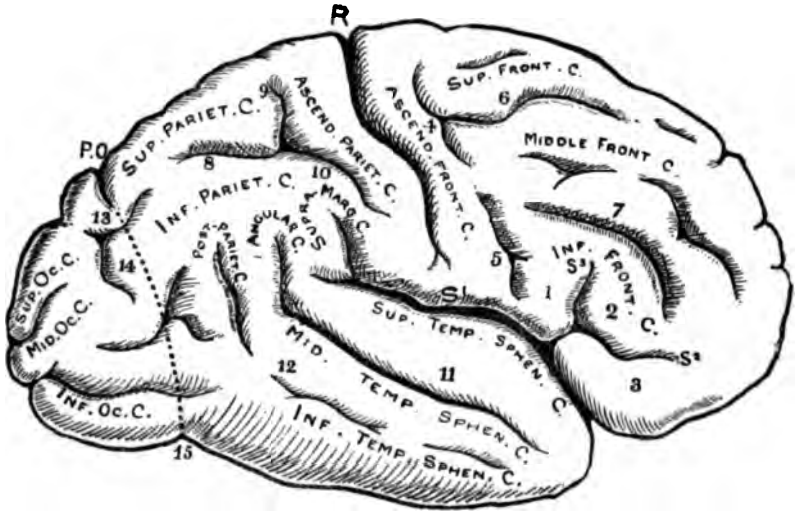

FIG. 570.—OUTER SURFACE OF BRAIN, DIAGRAMMATIC.

INNER SURFACE OF THE HEMISPHERE.—A Note to p. 288.

Two fissures are given off from the calloso-marginal, which are neither very well marked nor very constant, but are of value as affording useful lines of demarcation. They are the sulcus paracentralis and the sulcus subparietalis.

The *sulcus paracentralis* (22) turns upwards a little in front of the ascending terminal part of the calloso-marginal fissure, and, with this ascending part of the calloso-marginal fissure, bounds the *paracentral lobule*, which latter corresponds, on the mesial surface of the hemisphere, to the ascending frontal and ascending parietal, or pre- and post-central, convolutions of the outer surface. On this lobule, about midway between the ascending terminal parts of the paracentral and calloso-marginal fissures, may be seen the backward termination of the fissure of Rolando (*R.*), – in those cases, that is, in which the latter fissure reaches and turns over the mesial margin of the hemisphere.

The part of the paracentral lobule in front of the fissure of Rolando is taken, with the marginal convolution, to belong to the frontal lobe; the part of the paracentral lobule behind the fissure of Rolando is taken, with the quadrate lobule, to belong to the temporal lobe.

The *subparietal fissure* (23) passes backwards from the upward bend of the calloso-marginal fissure, and separates the quadrate, or precuniate, lobule from the convolution of the corpus callosum, or gyrus fornicatus, – that is, from the limbic lobe, – hence the term of *post-limbic* sometimes applied to this fissure.

The marginal convolution proper is continuous over the mesial border of the hemisphere with the superior frontal convolution of the outer surface of the hemisphere, and with the gyrus rectus of the under or orbital surface.

The *calcarine fissure* (17) commences near the occipital pole in a bifid extremity; it arches forward to join the internal parieto-occipital fissure (P.O.), forming with the latter a Y-shaped arrangement, of which the stem indents the isthmus of the conjoined callosal and hippocampal gyri a little below the splenium of the corpus callosum. This stem, or anterior part of the calcarine fissure, is by far the deepest part of the fissure; it is a complete fissure, which indents the wall of the hemisphere, and gives rise to the hippocampus minor, or calcar avis, in the posterior cornu of the lateral ventricle.

The *gyrus dentatus* (18) is a narrow convolution toothed or notched at its free border, which lies above the dentate or hippocampal fissure and hippocampal gyrus, and below the corpus fimbriatum, which overlaps it. It begins at the splenium of the corpus callosum, where it is continuous with both sets of striæ longitudinales on the upper surface of the latter. From this point it curves forwards along the isthmus and the upper border of the hippocampal gyrus, to be apparently lost beneath the uncus.

The *dentate or hippocampal fissure* (19) begins at the splenium of the corpus callosum, passes forwards between the gyrus dentatus above, and the isthmus of the hippocampal gyrus below, becoming deeper as it passes forwards, thus indenting the wall of the hemisphere so as to give rise to the hippocampus major or cornu Ammonis in the descending horn of the lateral ventricle. It ends beneath the uncus.

In connection with the delimitation of the limbic lobe, the *hippocampal gyrus* is now divided into an anterior portion, the hippocampal gyrus proper, situated in front of the isthmus of the gyrus fornicatus, and a posterior portion, the lobulus lingualis, situated below & behind the isthmus, which latter has nothing to do with the limbic lobe. The *lingual lobule* is bounded by the calcarine fissure and its junction with the internal

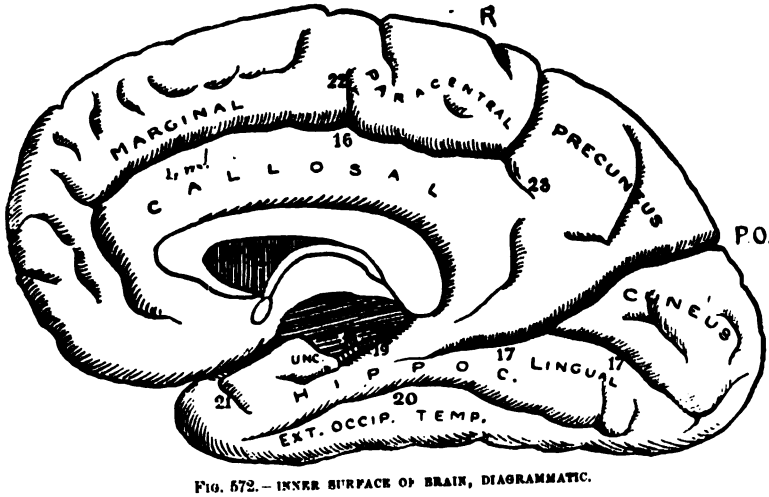

FIG. 572.—INNER SURFACE OF BRAIN, DIAGRAMMATIC.

parieto-occipital fissure above, and by the collateral fissure (20) below. It lies partly on the mesial surface, and partly on the tentorial surface of the occipital lobe. The *hippocampal gyrus*, as a whole, is separated in front from the external occipito-temporal convolution by the faintly marked and variable incisura temporalis (21).

The *internal parieto-occipital fissure*, P.O., marks distinctly the boundary between the occipital and temporal lobes on the mesial surface of the hemisphere. The boundary, on the tentorial surface, between the occipital lobe, on the one hand, and the temporal and limbic lobes on the other, is, on the contrary, not marked off in any way

FIG. 574.—DIAGRAM OF THE LIMBIC LOBE. (Quain.)

LOBES BUILT UP ON (I.) PHYSIOLOGICAL AND (II.) MORPHOLOGICAL GROUNDS.

I.

OPERCULAR LOBE (MACALISTER).

Surrounds the fissure of Rolando, or central fissure, and contains the motor areæ. It comprises the *precentral* or ascending frontal convolution, the *post-central* or ascending parietal convolution, the *paracentral* convolution joining the two foregoing above, and the *infracentral* convolution joining the same below.* The motor areæ correlated with the facial movements lie in the anterior part of the infracentral convolution; those correlated with the movements of the upper limb lie in the middle portions of the pre- and post-central convolutions; those correlated with the movements of the lower limb lie in the upper part of the pre- and post-central convolutions, and in the contiguous parts of the paracentral convolution.

* Professor Macalister does not recognise the frequent communications between the fissure of Rolando and either or both the longitudinal fissure and the horizontal limb of the fissure of Sylvius, said to be frequent by Professor Cunningham and other scientists. In consequence of the recognition of the opercular lobe, Professor Macalister's frontal and parietal lobes are shorn of their ascending frontal and ascending parietal convolutions respectively.

II.

LIMBIC LOBE OF BROCA, FALCIFORM LOBE OF SCHWALBE.

Encircles the corpus callosum and the basic ganglia, and is circularly continuous.

As first defined by Broca, it consisted of the callosal and hippocampal gyri, which are distinctly continuous behind, at the isthmus, and which are joined together in front, at least in all osmatic mammals, by the inner and outer roots of the olfactory nerve.*

To Broca's limbic lobe there have been added (Schwalbe, Zuckerkandl, and other scientists) the striæ longitudinales and the peduncles of the corpus callosum, – looked upon as rudimentary gyri, – the septum lucidum, dentate convolution, fornix, and cingulum.

Posteriorly, the striæ longitudinales laterales are prolonged upon the back part of the dentate and hippocampal convolutions; and anteriorly, the peduncles of the corpus callosum reach the uncus of the latter convolution by crossing the grey matter of the anterior perforated space. Here is therefore a second circularly completed gyrus (gyrus marginalis, or Randwindung of the Germans), curved round the brain-stem like the larger completed callosal and hippocampal gyri, concentric to, and included within the circle of the latter, – a necessary addition, it is contended, to the limbic lobe as first constructed.

The striæ longitudinales laterales are now looked upon as a rudimentary *gyrus supracallosus*, best developed in osmatic mammals, and which consists, in addition to the striæ, of a very thin lamina of grey matter continuing the grey matter of the gyrus fornicatus over the side of the upper surface of the corpus callosum. Similarly, the peduncles of the corpus callosum are looked upon as a rudimentary *sub-callosal gyrus*, which is really but a part of the supracallosal gyrus, – the two halves of the morphological unit having been separated only at the time of the appearance of that great transverse commissure, the corpus callosum. This sub-callosal gyrus, also best marked in the mammals named, and particularly in the monkey, is a band of grey matter wedged in, in the monkey, on each side of the middle line, between the fornix and the corpus callosum. This band is continuous with the degenerate grey matter of the septum lucidum, which may be looked upon as forming part of the same convolution.

With the above marginal gyrus may further be associated another rudimentary (or degenerate) gyrus, the *gyrus geniculi*, represented in man by the cingulum, and also, most probably, the stria medialis. The cingulum is a tract of fibres beginning at the anterior perforated space, and running circularly in the substance of the callosal and hippocampal convolutions. As they pass backwards, many of its fibres diverge at intervals from the main bundle, and become connected with the neighbouring grey matter of the cortex.

Further, certain patches of grey matter are said to occur in the substance of the fornix, which latter, considering the circular course of its fibres as prolonged into the anterior and posterior pillars, is now also, as a rudimentary gyrus, included in the limbic system.

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* The inner root of the olfactory nerve curves inwards, and may be traced into the anterior extremity of the callosal gyrus. The outer root runs backwards over the outer part of anterior perforated space, and in man becomes lost to view; but in osmatic mammals it may be traced into the uncinate extremity of the hippocampal gyrus.

It may be added that in man the limbic lobe is but partly circumscribed, its only distinct boundaries being the calloso-marginal fissure and the front part of the collateral fissure, – though posteriorly it is partly separated from the quadrate lobule by the less constant sub-parietal, or, in morphological language, post-limbic, sulcus. In many of the lower animals it is distinctly circumscribed by one continuous fissure, the limbic fissure of Broca, – which fissure is now termed, however, the *outer* limbic fissure, since there is now recognised an *inner* limbic fissure (continuous callosal, and choroid, or hippocampal fissures), separating the outer and inner limbic circles.

In all probability this "inner limbic fissure" will soon have to be called the "middle limbic fissure," and a further *inner* limbic fissure will have to be recognised, separating the fornix from the optic thalamus and brain-stem. If the fornix is to be a part of the limbic system, there are three limbic circles, and, therefore, there must be three limbic fissures.*

The limbic lobe is connected by more or less distinct annectent gyri with the lingual gyrus of the temporal lobe, the orbital gyri of the frontal lobe, the post-central lobule of the insula, and with the cuneate and quadrate lobules.

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* Speaking seriously, and as men with a responsibility on our shoulders, is it not evident that to take in the bearing of the generalisations upon which rests the recognition of the limbic system is beyond the scope of the practical work of any medical man, – one would almost say beyond the powers of a medical man, as such? If this kind of Anatomy is to be insisted upon, we are surely not far from the deadlock foreseen, evidently with deep anxiety, by Professor Macalister.

III.

INTERIOR OF THE BRAIN.

(These Notes should be read in conjunction with the pages they are respectively stated to refer to.)

Parts seen in Posterior & Descending Cornua.—A Note to pp. 296 & 300.

The *calcar avis* and the bulb of the cornu are now placed by some anatomists on the *inner wall* of the posterior cornu, and not on its floor; and below them, on the floor of the cornu, there is said to be, an elevation caused by the fasciculus longitutidinalis inferior.

Similarly, the hippocampus major, pes hippocampi, corpus fimbriatum, and choroid plexus are now placed by some on the *inner* wall of the descending cornu. And on the roof of the cornu there is said to be an elevation, the *amygdaloid tubercle*, due to the projection of the amygdaloid nucleus, or enlarged extremity of the narrow posterior part of the caudate nucleus, into which the tænia semicircularis is also prolonged.

It will be noticed that the Tablets, as opposed to the Notes, make no mention of the amygdaloid tubercle on the roof of the descending cornu. The structure may be seen in hardened sections, but the Author could never convince himself of its being visible in the brain on the dissecting room table. Gray, Ellis, Holden, and Heath never saw it; neither did Hirschfeld. The description is an example, to the Author's mind, of the importation of interpretational Anatomy into what purports to be dissectional Anatomy.*

* As confirming the view contended for, there have been placed side by side, p. 348t, the illustrations of the descending cornu of the lateral ventricle given, on the one hand, by Hirschfeld, and, on the other, by Schwalbe. The interpretational anatomist, Schwalbe, introduces the amygdaloid tubercle, *t.a.* (on section only), which Hirschfeld does not show; and he shows an "eminentia collateralis" quite different from what Hirschfeld represents, and such as the Author, certainly, has never seen.

deftly with the delicate adherent intestine; through the linea semilunaris, find the pylorus in the midst of those adhesions, altered appearances, and displacements. What serves "scientific" Anatomy here? What help generalisations on the persistence of the metameric arteries, or on the Treitz's fourth portion of the duodenum? Remove that cancerous tongue. What is the advantage of having been lectured to as to the supposed primitive duct of the thyroid?

We are rightly proud of the recent progress, - indeed, evolution, - of surgery. What is it due to in the main? *To Lister's antiseptiicism.* There is no connection whatever between the improved surgical therapeutics and the form of Anatomy now being pushed to to the front. Let the physiologist claim to have suggested the advances in brain surgery. Such honour may legitimately be placed to his credit. But who carried physiological discoveries into effect in man? Who trephined the human skull to expose the motor area? Who excised the Gasserian ganglion? Anatomists of the new school? Certainly not. Men reared in the dissecting room. Experimentally, physiology has brought almost every organ and tissue of the body within the reach of treatment. Great is the honour. But who is to carry out *in man* the behests of the younger and more progressive science? The physiologist himself, the physiological anatomist, who bases his knowledge of adult man on the study of the embryo, or on that of the lower animals? No. The human anatomist, who bases his knowledge on dissecting. All credit to the scientists for their great and noble work. But let them not spoil it by tying down to abstract doctrines leading to ignorance of patent and tangible fact in regard to man himself, the very hands which are to bring forth the practical results on which their glory rests.

Writes R. G. Patteson, Surgeon to Meath Hospital:—

> "Anatomy is not taught as the handmaid of Surgery, but as a separate science bristling with technicalities and overloaded with trivial and exasperating details. Hence it is unwillingly learnt, and readily forgotten. And the vast majority of facts, which are all-important in surgery, are soon engulfed in the wreckage which follows the emancipation of an over-burdened memory when the examination is passed."

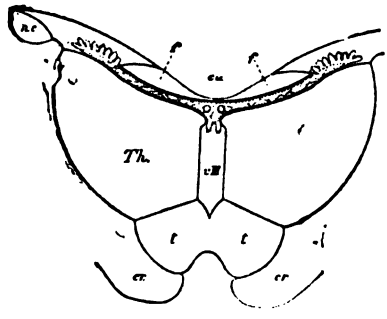

FIG. 577.—DIAGRAMMATIC SECTION THROUGH OPTIC THALAMI AND PARTS IN RELATION TO THEM. (Schwalbe.)

Showing how the velum interpositum and choroid plexuses are *excluded* from the lateral & third ventricles by the reflections of the ventricular epithelium. *VIII*, third ventricle; *Th*, optic thalamus; *f*, *ca*, fornix, corpus callosum; *cr*, *t*, crus cerebri, tegmentum.

The Third Ventricle.—A Note to p. 310.

The third ventricle is said to present four recesses (*see* Figs. 578, 579). At the lower and front part there is said to be a small recess just above the optic commissure, and a funnel-shaped prolongation into the infundibulum of the pituitary body. And at the upper and back part there are described the *recessus pinealis* and the *recessus suprapinealis*. The former of these is a slight prolongation of the ventricular cavity into the stalk of the

pineal body. The latter results from the mode of reflection of the ventricular epithelium on to the under surface of the velum interpositum. The ventricular epithelium passes backwards over the anterior half or two-thirds of the upper surface of the pineal body before being reflected upwards and forwards on to the velum. The recess thus caused cannot, of course, be seen in ordinary dissecting, but it appears as a projection on a cast of the ventricular cavity.

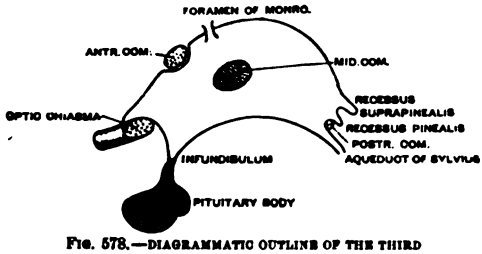

FIG. 578.—DIAGRAMMATIC OUTLINE OF THE THIRD VENTRICLE AS SEEN FROM THE SIDE. (Cunningham.)

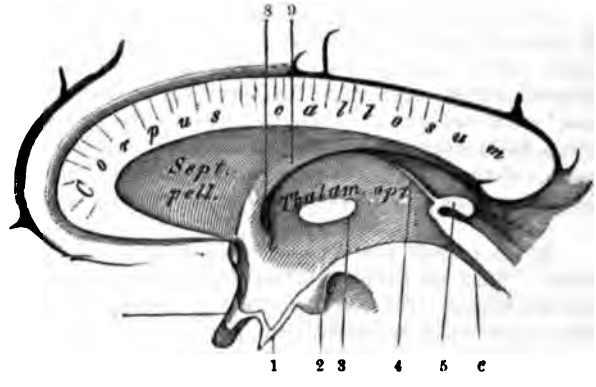

FIG. 579.—MESIAL SECTION PRESENTING THE SAME VIEW. (Gegenbaur.)

1, infundibulum; 2, corpus albicans; 3, grey commissure; 4, stria fornicis; 5, pineal gland; 6, aqueduct of Sylvius; 7, optic chiasma; 8, fornix; 9, foramen of Monro.

It is still stated by advanced, as it always has been by dissectional, anatomists, that the anterior extremities of the velum interpositum pass from the 3rd into the lateral ventricles through the foramina of Monro. It will easily be seen that the statement is not correct from the modern standpoint: The apertures of communication between the lateral and 3rd ventricles, taken in the modern sense, or *embryologice*, being the apertures of communication between the cavities bounded by the *epithelial linings* of these cavities. these apertures of communication themselves, or the foramina of Monro taken *embryologice*, must of a necessity be bounded by their own epithelial lining; and, as the choroid plexuses lie behind and outside this epithelial lining, these are necessarily foreign to the

foramina of Monro taken *embryologice*. In describing the ventricular cavities of the brain, one must either take the epithelium into consideration all round, or ignore it all round. One must admit that the roof of the 3rd ventricle is formed by the velum interpositum and the fornix, and that the velum interpositum and choroid plexuses penetrate into the lateral and 3rd ventricles, as hitherto stated; or, if this is rejected, one must admit that the choroid plexuses do not pass through the foramina of Monro, *as defined de novo in harmony with embryological views.*

The *anterior commissure* appears as a transverse band between the anterior crura of the fornix, where it presents a cylindrical surface turned towards the 3rd ventricle. It passes outwards on each side below the lenticular nucleus, and, inclining backwards and assuming a twisted appearance, ends in the temporal lobe.

Medulla Oblongata.—Notes to p. 318.

(*) This is of course incorrect from the *structural* point of view, since the medulla contains, not only the elements of the cord, re-arranged, but also additional structures, and has further lost some of the parts which the cord contained.

(†) The term "anterior pyramid" is used here in its obvious and original sense. In connection with questions of structure, the term is now often used in two other senses, both at variance with the above, namely, on the one hand, as designating the decussating fibres only, and, on the other hand, as comprising the whole of the "anterior area" of the medulla (more correctly, of the central or tripartite portion of the medulla, *vide* p. 348ii) comprised between the anterior median fissure and the roots of the hypoglossal nerve, – that is, in senses convenient for the purposes of structural descriptions, but which do not harmonise with the external or surface anatomy of the part.

(§) An entirely new meaning has also been given of late to the term "arciform fibres." What are described in the Tablet are the obvious arched fibres, which any dissector can see. The term is now made to embrace all that most complicated system of transverse fibres of the medulla and pons, whether arched or not, which enter into the riticular formation, and which the dissector certainly cannot see. (*Vide* Arciform Fibres and Olivary Nucleus, p. 348jj.)

(¶) The term "restiform body" is now applied, in structural Anatomy, to *the upper part only* of the restiform body of dissectional Anatomy, the reason being that the fibres of the fasciculi cuneatus & gracilis appear to end in the corresponding nuclei, and that the upper part of the restiform body of the dissectional anatomist appears to be formed by the newly described arciform fibres (see above), and by other fibres derived from the nuclei above mentioned.

The above are but instances of the present tendency to allow questions of minute structure to preponderate over distinct outward appearances. It is submitted that, when outward appearances and internal configuration do not agree, they should be taken separately, and independently of each other, as has been attempted in this Edition of the Tablets, rather than forced into apparent agreement by an alteration of the meaning of old and well-recognised terms.

IV.

MINUTE VASCULARISATION OF THE BRAIN.

The arteries as they reach the brain may be divided into two systems, the *central or ganglionic*, and the *peripheral or cortical* (Charcot), – the former ending in what are called "terminal," the latter in what are called "semi-terminal," arterioles (Cohnheim). The "terminal" arterioles are such as, from their origin to their termination, neither receive nor give off any anastomotic branches, so that, by these arterioles, only a precisely limited area of tissue is supplied, or can be injected. The semi-terminal arterioles are such as very sparingly give off, or receive, anastomotic branches, so that the injection of one area by the arteriole of an adjoining area, though not impossible, is difficult, and is only effected through vessels of very small size. The central or ganglionic, and the peripheral or cortical, systems in no way communicate, and are thus entirely independent one of the other. There exists, therefore, on the borderland of the two systems a stratum of brain substance but slightly vascular, of diminished nutritive activity, and specially exposed to softening.

The **central or ganglionic system** presents the following sets of arterioles: –

ANTERO-MEDIAN, – derived from the commencement of the anterior cerebrals, and from the anterior communicating. These vessels pierce the anterior perforated space and the lamina cinerea, and supply the head of the caudate nucleus.

POSTERO-MEDIAN, – derived from the commencement of the posterior cerebrals and from the posterior communicating. These pierce the posterior perforated space, and supply the inner surfaces of the optic thalami and the walls of the third ventricle.

ANTERO-LATERAL, – derived from the middle cerebrals. These vessels pierce the anterior perforated space, and supply the caudate and lenticular nuclei, the internal and external capsules, and part of the optic thalamus. One of the arteries of this group, larger than the others, is specially liable to be ruptured, and is termed by Prof. Charcot the "artery of cerebral hæmorrhage."

POSTERO-LATERAL, – derived from the posterior cerebrals just after they have wound round the crura cerebri. These vessels supply a considerable portion of the optic thalami and corpora quadrigemina.

A circle drawn at a distance of about an inch from the circle of Willis would include the origin of all the foregoing arteries.

The **peripheral or cortical system** consists of branches of the anterior, middle, and posterior cerebral arteries, which enter the cortex perpendicularly after ramifying in the pia mater. They are divided into short and long. The *short* arteries are confined to the cortex, where, in the middle zone of grey matter, they form a close network with the branches given off from the long arteries. The *long or medullary* arteries traverse

the grey matter, and penetrate the white or medullary substance to a depth of about an inch and a half without communicating with each other or with the short arteries, except by very small capillaries. They are thus "semi-terminal," or not so strictly terminal as the arterioles of the central or cortical system.

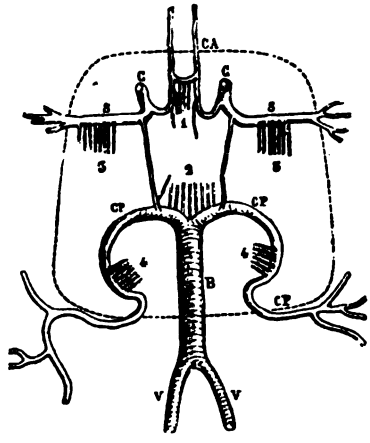

FIG. 580.—DIAGRAM OF THE CIRCLE OF WILLIS AND ITS *central or ganglionic branches.* (Charcot, Macalister.)

V, B, C, vertebral, basilar, and internal carotid arteries; CA, CP, S, anterior, posterior, and middle cerebral arteries; 1, 2, 3, 4, antero-median, postero-median, antero-lateral, and postero-lateral terminal arterioles.

GENERAL DISTRIBUTION OF THE THREE CEREBRAL ARTERIES TO THE CORTEX:—

ANTERIOR CEREBRAL ARTERY.

Whole of inner surface of hemisphere from the anterior pole to close upon the internal parieto-occipital fissure.

A strip of the outer and under surfaces of the hemisphere running along the corresponding portions of the longitudinal fissure. This strip is narrow both over the parietal lobe, where it includes the upper part only of the superior and ascending parietal convolutions, and also on the under or orbital surface of the frontal lobe, where it includes the straight and internal orbital convolutions. It widens out over the outer surface of the frontal lobe, where it includes the upper part of the ascending frontal convolution, the superior frontal convolution, and the anterior two-thirds of the middle frontal convolution.

MIDDLE CEREBRAL ARTERY.

Whole of parietal lobe, except the narrow strip above referred to.

Temporal lobe:-Superior temporal convolution and the greater part of the middle temporal convolution; anterior extremity of internal and external occipito-temporal convolutions.

Frontal lobe:-Lower and back part of convex surface, including the inferior frontal convolution, the posterior third of the middle frontal convolution, and the ascending frontal convolution, except quite its upper part;-the orbital surface externally to the internal frontal convolution.

POSTERIOR CEREBRAL ARTERY.

Whole of occipital lobe, with the adjacent portion of the quadrate lobule.

Inferior temporal convolution, and lower part of the middle temporal convolution.

Internal and external occipito-temporal convolutions, except their anterior extremity.

THE SEVERAL CORTICAL BRANCHES OF THE ABOVE ARTERIES, WITH THE PARTS THEY SUPPLY, MAY BE TABULATED AS FOLLOWS :—

ANTERIOR CEREBRAL ARTERY.	*Inferior internal frontal.* - Two or three. Supply the gyrus rectus, the olfactory peduncle and bulb, and the internal orbital convolution.
	Anterior internal frontal. - Supply the front part of marginal and callosal gyri, and neighbouring part of outer surface of hemisphere.
	Middle internal frontal. - Supplies the paracentral lobule, and neighbouring part of outer surface of the hemisphere.
	Posterior internal frontal. - Supplies the greater part of the cuneate lobule and neighbouring part of outer surface of hemisphere.
MIDDLE CEREBRAL ARTERY.	*External orbital, Inferior frontal, Ascending frontal, Ascending temporal.* - Supply the convolutions of same name.
	Parieto-temporal. - Relatively large branch issuing from the back part of the posterior limb of the fissure of Sylvius, and supplying the central part of the parietal lobe.
	Temporal. - Supply the superior temporal convolution and the upper part of the middle temporal convolution.
POSTERIOR CEREBRAL ARTERY.	*Temporal.* - Two or three. Pass outwards over the hippocampal gyrus, and ramify on the under & outer surfaces of the temporal & occipital lobes.
	Calcarine. - Runs along the calcarine fissure, and supplies the cuneus, the lingual lobule, and outer neighbouring outer surface of hemisphere.
	Parieto-occipital. - Runs up in the parieto-occipital fissure, and supplies the cuneus and precunius, and neighbouring part of outer surface of hemisphere.

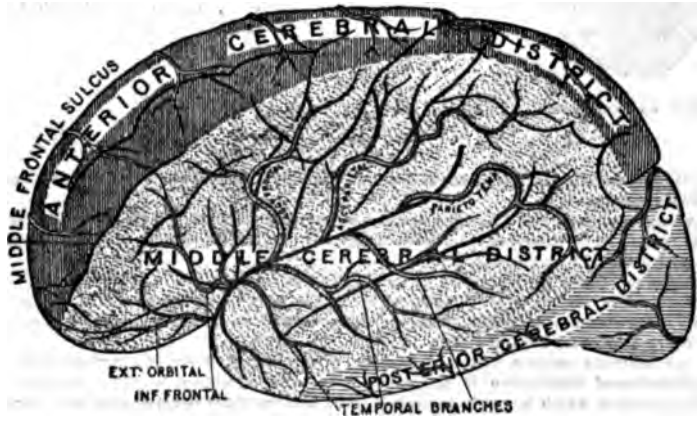

FIG. 581.—ARTERIAL DISTRIBUTION ON OUTER SURFACE OF HEMISPHERE. (Cunningham.)

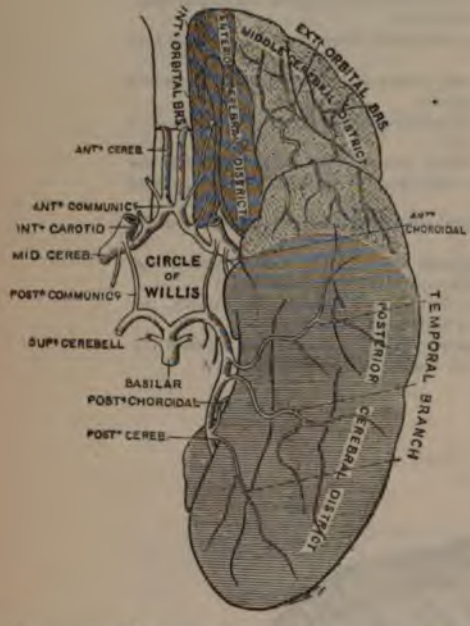

FIG. 583.—ARTERIAL DISTRIBUTION ON UNDER SURFACE OF BRAIN. (Cunningham.)

FIG. 582.—ARTERIAL DISTRIBUTION ON INNER SURFACE OF HEMISPHERE. (Cunningham.)

It will be seen that the minute vascularisation of the brain has been treated apart from the course and general distribution the arteries which reach that organ.

The subject, which originated with Charcot's lectures on cerebral localisation published in Paris in 1876, is one and undivisible,—a unit as regards both the premises submitted and the conclusions reached,—Charcot's preamble, in fact, to the clinica study of cerebral degeneration and hæmorrhage.

In the usual way of presenting it, it is broken up into bits. The six branches of the ganglionic system are distributed among the several tributaries of the circle of Willis: two go to the anterior cerebrals, one to the anterior communicating, one to the basilar, two to the posterior cerebrals. These are thus presented, as a rule, several pages apart. The same thing is repeated in regard to the arteries of the cortical system.

When tracing out either the anterior, middle, or posterior cerebral artery, it may nicely round off the customary statement to give the minute physiological distribution of the same. But such advantage has its drawbacks. It is through this splitting up of subjects, a practice which is yearly increasing, that modern study becomes more and more a burdening of the memory, and the examination, in a measure, a test as to mere remembering.

V.

CRANIO-CEREBRAL TOPOGRAPHY.

The relations of the convolutions to surface markings are variable within certain limits, not only at different ages and in the two sexes, but in different individuals of the same age and sex, and therefore can only be relied upon as approximations. It is doubtful, indeed, how far there is constancy of position of any group of nerve cells; and "it is possible that, while each group may occupy a constant position with regard to its neighbours, yet, on account of the varying development of the several areas, the absolute sites of each group are not as constant as their relative positions, and that a group which in one brain occupies the crest of a convolution, may be in another on the slope of a gyrus, or even in the trough between two gyri. The patterns of the convolutions are but expressions of the relative rates of growth of the different areas of the surface."—(Macalister.)

1.—The Four Cardinal Points on the Cranial Surface.

Bregma.—Junction of the coronal and sagittal sutures; lies in the centre of a line drawn across the vertex from one external auditory meatus to the other, the head being in its usual erect position, – that is, the upper border of the zygoma being horizontal. It corresponds to the anterior fontanelle, which is diamond-shaped in the infant.

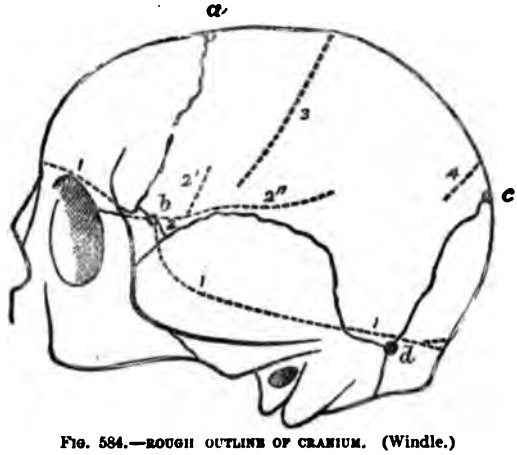

FIG. 584.—ROUGH OUTLINE OF CRANIUM. (Windle.)

a., bregma; *c.*, lambda; *d.*, asterion; *b.*, pterion; 1, lower level of brain; 2, stem; 2', ascending limb; 2'', posterior limb of fissure of Sylvius; 3, fissure of Rolando; 4 external parieto-occipital fissure, (Windle.)

Lambda.—Junction of the sagittal and lambdoid sutures; lies $2\frac{3}{4}$ inches above the external occipital protuberance, and may often be felt through the scalp as a slight

depression. It corresponds to the posterior fontanelle, which, in the infant, is triangular with apex forwards.

Asterion.—Junction of the lambdoid and squamous sutures; lies ¾ of an inch behind and ½ an inch above the upper part of the posterior border of the mastoid process.

Pterion.—The H-shaped junction of the frontal, parietal, sphenoid, and temporal; its anterior end lies 1¼ to 1½ inches behind and a little above the external angular process; its posterior end lies about ½ an inch further back.

See further pp. 85 & 86 of the Osteology.

2.—The Sutures.

Sagittal.—From the bregma to the lambda.

Lambdoid.—From the lambda to the asterion, and then along the posterior border of the mastoid process.

Coronal.—From the bregma downwards and forwards, past the anterior end of the pterion, to just below and behind the external angular process.

Squamous.—Marked by a curved line from the back part of the pterion to the asterion, the highest part of which line is about 2 inches above the zygoma.

3.—The Sinuses.

Superior Longitudinal.—From glabella, or nasal eminence of the frontal bone, to external occipital protuberance.

Lateral.—From external occipital protuberance to asterion, and then along the posterior border of the mastoid process.

4.—Lower Brain Levels.

Occipital Lobe.—From external occipital protuberance to asterion.

Temporal Lobe.—Line rising first slightly and then abruptly from the asterion to the pterion.

Frontal Lobe.—From pterion along upper margin of superciliary ridge.

5.—Interlobar Fissures.

Fissure of Sylvius (Reid's Method).—Draw a line from 1¼ *inches behind* the *external angular process* of the frontal to a point ¾ of an inch below the most prominent point of the parietal eminence (Fig. 585). The first three-quarters of an inch will represent the stem of the fissure; the remainder will represent its posterior or horizontal limb. The bifurcation, or rather trifurcation, lies, therefore, 2 inches behind and a little above, say a quarter of an inch above, the external angular process. From this point the ascending limb passes upwards and forwards parallel to, and a little behind, the coronal suture.

Fissure of Rolando (Reid's Method).—Draw a base line from the *lowest part of the infra-orbital margin* through the middle of the external auditory meatus to the back of the head (Fig. 585). Draw two lines perpendicular to the above – the one from the depression in front of the external auditory meatus, and the other opposite the posterior border of the mastoid process at its root to the middle line of the head, taken as drawn: there is now constituted a four-sided figure. The diagonal drawn from the

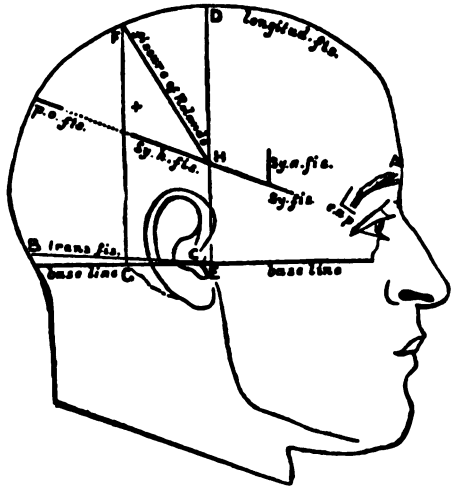

FIG. 585.—RELATION OF PRINCIPAL FISSURES AND CONVOLUTIONS TO THE OUTER SURFACE OF THE SCALP. (Reid.)

posterior-superior angle to the point where the anterior perpendicular crosses the fissure of Sylvius will represent the fissure of Rolando.

Other methods:

Upper end of the Fissure—Lies half an inch behind the mid-point of the vertex, – that is, half an inch behind the middle of the distance between the external occipital protuberance and the nasal eminence, or glabella (Thane). (It may perhaps be more correct to fix the upper end of the fissure at a distance from the external occipital protuberance equal to 55·6 per cent. of the distance between that point and the glabella.) From its upper end the fissure passes downwards and forwards for $3\frac{3}{4}$ inches, forming an angle of 67° (Cunningham says 71·5°) with the middle line of the head.

Lower end of the Fissure.—Lies half an inch behind the bifurcation of the fissure of Sylvius, and close to its horizontal limb (Thane).

External Parieto-occipital Fissure.—Runs for about an inch at right angles to the middle line of the head from a point $\frac{1}{2}$ of an inch in front of posterior fontanelle or lambda, and lies in a line with the posterior or horizontal limb of the fissure of Sylvius.

FIG. 586.—CAST PREPARED BY PROF. CUNNINGHAM TO ILLUSTRATE CRANIO-CEREBRAL TOPOGRAPHY. (Macalister.)
Drawn by kind permission of Prof. Cunningham.

VI.

MEDULLA OBLONGATA AND MESENCEPHALON (MESOCEPHALON.)

TRANSVERSE SECTIONS.

The leading structural features of the Medulla Oblongata, Pons, and Mesencephalon (Mesocephalon) will easily be made out from the following sections.

1. *Upper Part of Cord.* – The section shows the incipient decussation of the pyramids at the bottom of the antero-median fissure; the anterior cornua of the grey matter are already partly separated from the remainder of the grey matter. As

FIG. 587.—SECTION OF UPPER PART OF SPINAL CORD. (Quain.)

compared with sections lower down, the substantia gelatinosa of Rolando is already somewhat enlarged, and nearer to the surface. The central canal is already distinctly posterior to the centre of the cord.

2. *Medulla: Lower Part of Pyramid.* – The antero-median fissure is shallower, and the anterior commissure is now fully occupied by the pyramidal decussation. The

FIG. 588.—SECTION OF MEDULLA OBLONGATA AT LOWER PART OF DECUSSATION OF PYRAMIDS. (Lockhart Clarke.)

f., anterior; *f.p.*, posterior fissure; *a.p.*, pyramid; *a.*, remains of anterior cornu, separated by the decussating bundles from the rest of the grey matter; *l.*, continuation of lateral column of cord; *R.*, continuation of substantia gelatinosa of Rolando; *p.c.*, continuation of posterior cornu of grey matter *f.g.*, funiculus gracilis.

anterior cornua are completely cut off from the remainder of the grey matter, and pushed somewhat aside.

3. *Medulla: Upper Part of Pyramid and Lower Part of Olivary Body.* – The continuations of the anterior cornua are isolated masses of grey matter lying quite to the side, and known as the Lateral Nuclei (*n.l.*). The large claval and cuneate nuclei have made their appearance in the corresponding fasciculi, and by these the posterior cornua and substantia gelatinosa (*g.*) are so completely pushed outwards that the substantia gelatinosa reaches the surface and gives rise to the funiculus and tubercle of Rolando. The central canal lies well to the back, close to the bottom of the postero-median fissure, which is distinctly widening out. The grey matter around it contains two groups of nerve-

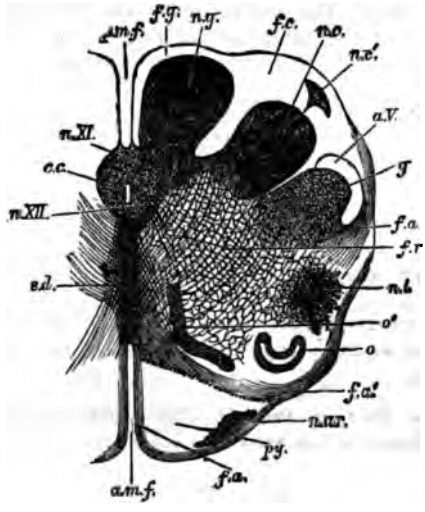

FIG. 589.—SECTION OF MEDULLA OBLONGATA IN UPPER PART OF PYRAMIDAL DECUSSATION. (Schwalbe, Quain.)

a.m.f., anterior median fissure; *f.a.*, superficial arciform fibres emerging from the fissure; *py.*, pyramid; *n.ar.*, nucleus of the arciform fibres; *f.a.'*, deep arciform fibres becoming superficial; *o.*, lower end of olivary nucleus; *o.'*, accessory olivary nucleus; *n.l.*, nucleus lateralis; *f.r.*, formatio reticularis; *f.a.*^{2}, arciform fibres proceeding from formatio reticularis; *g.*, substantia gelatinosa of Rolando; *a.V.*, ascending root of fifth nerve; *n.c.*, nucleus cuneatus; *n.c.'*, external cuneate nucleus; *f.c.*, funiculus cuneatus; *n.g.*, nucleus gracilis; *f.g.*, funiculus gracilis; *p.m.f.*, posterior median fissure; *c.c.*, central canal surrounded by grey matter, in which are, *n.XI.*, nucleus of the spinal accessory, and *n.XII.*, nucleus of the hypoglossal; *s.d.*, decussation of fillet or superior pyramidal decussation.

ells, one in front of the canal, and the other behind it: the *anterior cells* are the nucleus of the hypoglossal nerve (*n.XII.*); the *posterior cells* are the nucleus of the spinal accessory (*n.XI*). The remainder of the grey matter is broken up into the reticular formation. The olivary nucleus (*o.*) is small and of simple outline; the secondary olivary nucleus (*o.'*) is seen on its inner side. The ascending root of the 5th nerve (*a. V.*) is seen capping the substantia gelatinosa. As points of secondary importance, one may notice the arciform nucleus (*n.ar.*) lying external to the anterior pyramid, and the external cuneate nucleus (*n.c.'*) lying external and posterior to the principal nucleus of that name.

The *Formatio Reticularis* is a collection of grey matter lying behind the anterior pyramid and olivary body, and so named from its reticular appearance at low powers resulting from the crossing of somewhat large bundles of fibres longitudinal and transverse. The transverse fibres take a wavy course backwards and outwards from the raphé towards the gracile, cuneate, & olivary nuclei, and, in the upper part of the medulla, towards the restiform body (*i.e.*, the restiform body of the structural anatomist, or upper part of the restiform body of the dissectional anatomist). The longitudinal fibres belong anteriorly to the fillet or lemniscus (?), and laterally to the lateral column of the cord after it has given off the crossed pyramidal fibres and the direct cerebellar tract. The nerve-cells are specially large and numerous laterally (formatio reticularis grisea), but less so anteriorly (formatio reticularis alba). The formatio reticularis is prolonged throughout the medulla and the mesencephalon (mesocephalon), where it forms the greater part of the tegmentum of the crus cerebri.

4. *Medulla: Middle of Olivary Body.* – This is the most important section.

The central canal has expanded into the 4th ventricle. The two halves of the medulla are parted from each other by a broad median raphé, and each half is further

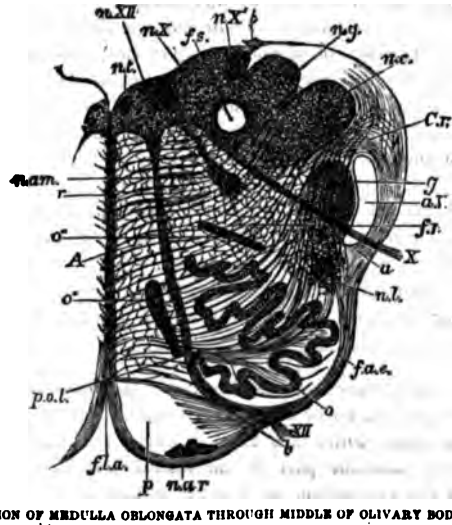

FIG. 590.—SECTION OF MEDULLA OBLONGATA THROUGH MIDDLE OF OLIVARY BODY. (Schwalbe.)

f.l.a., anterior median fissure; *n.ar.*, nucleus arciformis; *p.*, pyramid; *XII.*, bundle of hypoglossal nerve emerging from the surface; at *b*, it is seen coursing between the pyramid and the olivary nucleus, *o.*; *f.a.e.*, external arciform fibres; *n.l.*, nucleus lateralis; *a.*, arciform fibres passing towards restiform body partly through the substantia gelatinosa, *g.*, partly superficial to the ascending root of the 5th nerve, *a.V.*; *X.*, bundle of vagus root, emerging; *f.r.*, formatio reticularis; *c r.*, corpus restiforme, beginning to be formed, chiefly by arciform fibres, superficial and deep; *n.c.*, nucleus cuneatus; *n.g.*, nucleus gracilis; *t.*, attachment of the ligula; *f.s.*, funiculus solitarius; *n.X.*, *n.X.'*, two parts of the vagus nucleus; *n.XII.*, hypoglossal nucleus; *n.t.*, nucleus of the funiculus teres; *n.am.*, nucleus ambigtus *r.* raphe; *A.*, continuation of anterior column of cord; *o'*, *o''*, accessory olivary nuclei.

divided into three triangular areæ by the roots of the hypoglossal and pneumogastric nerves (*XII.*, *XX.*). It will be noted that it is only this central portion of the medulla

that is so divided, and not the whole length of the medulla. This central portion is the only one that is in any way tripartite.

The three areæ must be referred to separately.

a. – Anterior or Internal Area – Comprised between the median raphé and the roots of the hypoglossal nerve. This is occupied anteriorly by the pyramid (*p.*), and posteriorly by the formatio reticularis alba.

b. – Middle Area. – Comprised between the roots of the hypoglossal and pneumogastric nerves, this is occupied in front by a wavy line of grey matter, the nucleus of the olivary body, or corpus dentatum (*o.*); internal and posterior to this are the two accessory olivary nuclei. Posteriorly is the formatio reticularis grisea.

c. – Posterior or External Area. – Behind the roots of the pneumogastric nerve. This is occupied by a considerable portion of the grey matter of the floor of the 4th ventricle, greatly spread out. Here the anterior & posterior nuclei of the previous section have now become, the one *internal* (*XII.*), – nucleus of the hypoglossal nerve, – and the other *external* (*X.*); from this latter nucleus there now arises, not the spinal accessory nerve, as in the previous section, but the *pneumogastric*. Externally to the grey matter proper there are the prolongations of the claval and cuneate nuclei, and of the substantia gelatinosa of Rolando. The ascending root of the 5th nerve is again seen capping the substantia gelatinosa. As points of secondary importance, one may notice the fasciculus teres, or ascending intrapontine portion of the facial nerve (*n t.*), in the inner part of the grey matter, and a rounded bundle of white fibres, the funiculus solitarius (*f.s.*), situated a little internal and anterior to the claval nucleus, and which is supposed by some anatomists to be the root of the phrenic nerve.

The nucleus of the olivary body, or corpus dentatum, takes the form of a thin wavy lamina which is curved round at its edge so as to form an ovoid scalloped capsule. The open part, or hilum, of this capsule, looks towards the middle line and receives a considerable tract of white fibres, the so-called olivary peduncle, which emanate from the raphé, and are derived to all appearance from the opposite olive.*

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* "The fibres of the olivary peduncles diverge as they pass to the grey lamina. They are partly lost in the grey matter of the olivary nucleus, but mostly pass in small bundles through the lamina, those which are more posterior turning backwards and coursing obliquely through the posterior part of the lateral area to join the Restiform body and thus to pass to the cerebellum as internal arched fibres. Others, after coursing through the grey lamina and running between the longitudinal fibres which cover the olive, reach the surface, where they bend round and are continued as part of the layer of external arched fibres into the Restiform body. Through the Restiform body, the arched fibres and the fibres of the olivary peduncle, the cerebellar hemisphere of one side is connected, therefore, with the olivary nuclei of both sides. But the connection with the opposite side is the more intimate, for it is found that in cases of atrophy of the cerebellar hemisphere of one side, the olive of the opposite side is atrophied while that of the same side is intact." – ("Quain's Anatomy," 10th Edition.)

"The arciform fibres are distinguished into external & internal, or superficial & deep. The *outer or superficial arched fibres* emerge for the most part from the anterior median fissure, and, passing over the pyramids and olives, many of them go to the Restiform body.

5. Medulla: Upper Part of Olivary Body. – We are now above the point of special interest. It will be observed, to begin with, that the section is no longer tripartite, though otherwise resembling the foregoing in general outline. It is true that the nucleus of the hypoglossal nerve is still seen in the inner part of the grey matter, but its

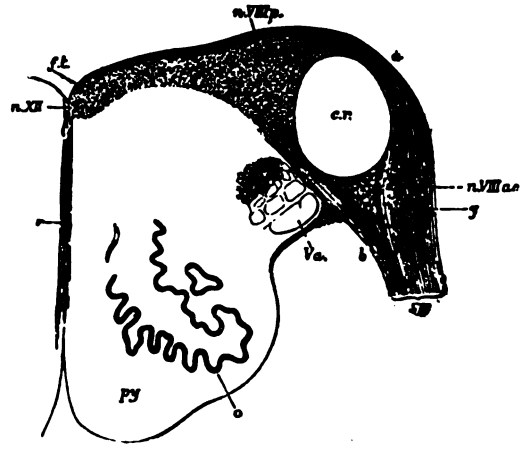

FIG. 591.—SECTION THROUGH UPPER PART OF OLIVARY BODY. (Schwalbe.)

py., pyramid; *o.*, olivary nucleus; *V.a.*, ascending root th fifth nerve; *VIII.*, inferior (posterior) root of the auditory nerve, formed of two parts, *a.* and *b.*, which enclose the restiform body, *c.r.*; *n.VIII.p.*, principal nucleus of the auditory nerve; *n.VIII.ac.*, accessory nucleus; *g.*, ganglion cells in the root; *f.t.*, funiculus teres; *n.XII.*, nucleus of the hypoglossal; *r.*, raphe.

roots no longer traverse the section. Nor, *à fortiori*, do those of the pneumogastric nerve, whose nucleus even has disappeared, – giving place to the principal nucleus of the nervus acusticus. The principal auditory nucleus, – the prolongation of the external group of cells in the grey matter of the previous section, and of the anterior group in the section before that, – is a large and important one, widely spread out over the broadest part of the floor of the ventricle, and deeply sunk into the grey matter. Running over it, – over the tuberculum acusticum of the surface description, – are seen the transverse bundles of the striæ acusticæ, joining to all appearances the large outer root

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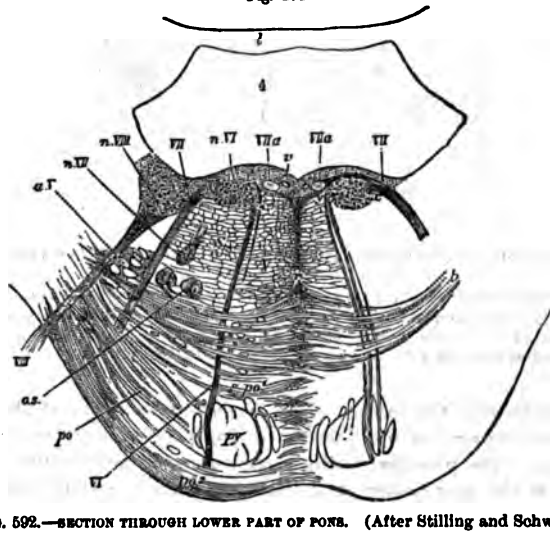
They are added to by deep fibres which come to the surface partly in the groove between the pyramids and olives, partly after passing through the olives, as before mentioned. Traced back into the anterior median fissure, they are seen to enter the raphé, and to cross over in it; after which it is supposed that they may become longitudinal, but their further course is not certainly known. The *inner or deep arched fibres* emerge from the raphé, and traverse the thickness of the bulb, tending towards the olives, the Restiform body, and the nuclei of the cuneate and slender funiculi. Those which pass through and in front of the olives are in continuity with the superficial arched fibres. Traced backwards into the raphé the deep arched fibres cross obliquely to the other side of the medulla, where some become longitudinal, joining the fibres of the fillet." – ("Quain's Anatomy," 10th Edition.)

of the auditory nerve. This root is seen to cross the restiform body externally; it contains a few nerve-cells. The smaller internal root of the same nerve is seen to arise from the ventral part of the nucleus, and to cross the inner aspect of the restiform body. Where the two roots join there is, in the angle between them, a small collection of nerve-cells, the accessory auditory nucleus. The section shows the ascending root of the 5th nerve (*Va.*) to the inner side of the inner auditory root.

6. *Mesocephalon: Through Lower Part of Pons.* – We are now clear of the medulla as regards external features and general outline; not quite so, however, as regards structural points. Here appear the numerous transverse fibres, superficial and deep, which pass from one hemisphere of the cerebellum to the other. Between them, still

Fig. 272.



[Fig. 592.—SECTION THROUGH LOWER PART OF PONS. (After Stilling and Schwalbe.)

py., pyramid-bundles continued up from the medulla; *po.*, transverse fibres of the pons passing rom the middle crus of the cerebellum, before (po^2) and behind (*po'*) the chief pyramid bundles; *t.*, deeper transverse fibres, constituting the trapezium; the grey matter between the transverse fibres is not represented either in this or in the following figures; *r*, raphe; *o.s.*, superior olivary nucleus; *a.V.*, bundles of the ascending root of the fifth nerve, enclosed by a prolongation of the grey substance of Rolando; *VI.*, the sixth nerve; *n.VI.*, its nucleus; *VII.*, the facial nerve; *VIIa.*, ascending portion of the facial root; *n.VII.*, its nucleus; *VIII.*, superior root of the auditory nerve; *n.VIII.*, part of the nucleus of Deiters.

forming a fairly compact mass, as compared with the arrangement further up, are seen the prolongation of the fibres of the pyramids (*py.*); also various deposits of grey matter, the nuclei pontis. Spread out over the dorsal aspect of the section is the grey matter of the upper part of the floor of the 4th ventricle, still presenting the auditory nucleus (*n. VIII.*) externally, but presenting, internally, two new nuclei, – that of the 6th nerve (*n. VI.*) nearest to the middle line, and that of the 7th nerve (*n. VII.*) more externally, and deeper, somewhat buried in the reticular formation. The bundle of the ascending roots of the 5th nerve (*a. V.*) is seen cut across between the root fibres of the auditory & facial nerves, enclosed in a prolongation of the substantia gelatinosa. The olivary body

is no longer visible, but in the antero-lateral part of the reticulnar formation there are one or two small collections of grey matter known as the superior olive. A special set of transverse fibres is here visible, the trapezium, probably connected with the cells of the superior auditory nucleus. Crossing the root fibres of the sixth and facial nerves, they run ventrally to the ascending root of the fifth nerve, and apparently join the accessory auditory nucleus and the ventral root of the auditory nerve.

A section a little higher up shows the motor nucleus of the 5th nerve, and part of its middle sensory nucleus,* with, in its midst, a few transversely cut fibres of the ascending root.

7. *Upper Part of Pons; Crura Cerebri, Valve of Vieussens.* – Here the pons shows simply its transverse fibres (*t.*) greatly broken up, between which are the correspondingly subdivided fibres of the pyramids (*py.*), and isolated clusters of grey matter. Dorsal to the pons, and separated from it by the still wide and undivided plane of the fillet (*l*, l^2), is the continuation of the formatio reticularis surmounted by the grey

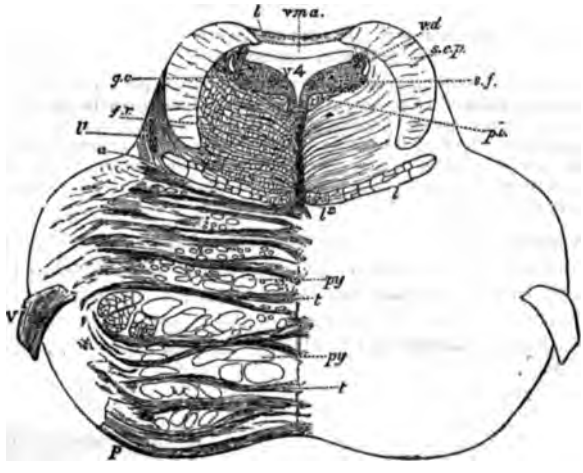


FIG. 598.—SECTION THROUGH UPPER PART OF PONS. (Schwalbe, after Stilling.)

t., transverse fibres of the pons; *py.*, *py.*, bundles of the pyramids; *a.*, boundary line between the tegmental part of the pons and its ventral part; *l'*, oblique fibres of the lateral fillet, passing towards the inferior corpora quadrigemina; *l.*, lateral; l^2, mesial fillet; *f.r.*, formatio reticularis; *p.l.*, posterior longitudinal bundle; *s.c.p.*, superior cerebellar peduncle; *v.m.a.*, superior medullary velum; *l*, grey matter of the lingula; *v.* 4, fourth ventricle; in the grey matter which bounds it laterally are seen, *v.d.*, the descending root of the fifth nerve, with its nucleus; *s.f.*, substantia ferruginea; *g.c.*, group of cells forming the nucleus of the 4th nerve.

matter of the floor of the upper or closed part of the 4th ventricle (*v.* 4), now rapidly narrowing into the aqueduct of Sylvius. On either side of this grey matter are the crescentic sections of the superior peduncles of the cerebellum (*s.c.p.*), joined mesially above by the valve of Vieussens or superior medullary velum (*v.m.a.*); over this is the section of one of the transverse bands of grey matter making up the lingula (*l*).

* The *upper* sensory nucleus according to Quain's description. *See* foot-note, p. 152[1].

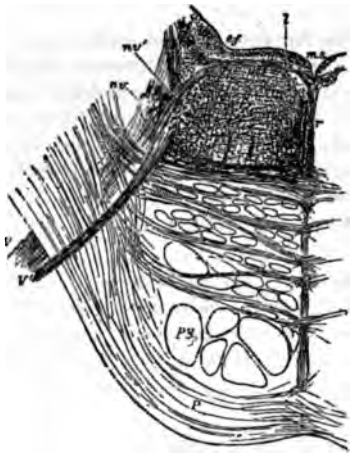
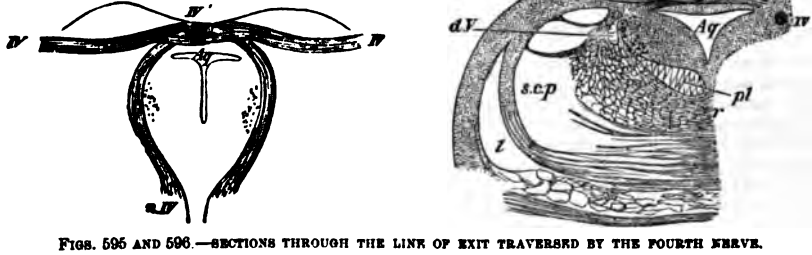


FIG. 594.—OBLIQUE SECTION OF PONS ALONG THE LINE OF EXIT TRAVERSED BY THE 5TH NERVE.
(Schwalbe, after Stilling.)

The section passes through the lower part of the motor nucleus (*nv'*), from which a bundle of fibre of the motor root is seen passing, *V'*; a part of the middle* sensory nucleus (*nv*) is also shown in the section in the form of a number of small isolated portions of grey matter. Amongst these are a few bundles of the ascending root cut across, but most of these have already become diverted outwards to join and assist in forming the issuing part of the main or sensory root, *V*; *l*, small longitudinal bundle of fibres near the median sulcus (*m.s.*), passing outwards to join the root of the 5th nerve; *f.r.*, formatio recticularis; *r*, raphe; *s.f.*, substantia ferruginea.

In the grey matter of the floor of the narrowing ventricle lies, close to the middle line, the nucleus of the 4th nerve (*g c.*). Externally to this is the descending root of the 5th nerve, with the corresponding nucleus. More deeply may be noticed the section of the substantia ferruginea, and, on the borderland of the formatio reticularis, the section of the posterior longitudinal bundle (*p.l.*) Outside the crus are seen the oblique fibres of the upper fillet (*l'*).

A. B.



FIGS. 595 AND 596.—SECTIONS THROUGH THE LINE OF EXIT TRAVERSED BY THE FOURTH NERVE.

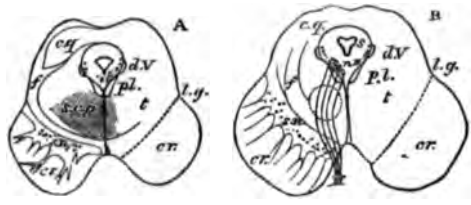
A: Oblique section through the nucleus, intra-pontine bundles, decussation, and point of emergence. B: Transverse section, showing surrounding parts. *n.IV.*, nucleus and intra-pontine bundles; *IV.'*, decussation in valve of Vieussens; *IV.*, the emerging nerves; *Aq.*, aqueduct of Sylvius with the surrounding grey matter, in which, on the right side, the nerve-bundle is seen divided just prior to the decussation; *l.*, fillet; *s.c.p.*, superior cerebellar peduncle; *d.V.*, descending root of fifth nerve; *p.l.*, posterior longitudinal bundle; *r*, raphe.

* The *upper* sensory nucleus according to Quain's description. *See* foot-note, p. 152q.

The roots of the 4th nerve are seen a little higher up to ascend in the grey matter on either side of the aqueduct, and to decussate mesially in the valve of Vieussens before emerging from the upper part of the same.

The *fillet or lemniscus* is formed by the fibres from the *cuneate and gracile nuclei*, which decussate behind the anterior pyramid, and then turn upwards. It forms at first a longitudinal bundle situated behind the pyramid, in the ventral part of the formatio reticularis. Here it divides into a large lateral portion, the lower fillet, a smaller mesial portion, the mesial fillet, and a middle portion, the upper fillet. The *lower fillet* passes obliquely upwards and outwards to the surface of the crus cerebri, and then curves upwards and inwards on the outer side of the tegmentum towards the inferior corpus quadrigeminum. The *mesial fillet* passes into the mesial part of the crusta at the side of the pyramidal tract, and is lost in the subthalamic region. The *upper fillet* is believed to be prolonged to the superior corpus quadrigeminum and to the occipital region.

8. – *Quadrigeminal Bodies, Crura Cerebri, Tegmentum, Aqueduct of Sylvius, Superior Peduncles of the Cerebellum:* – The transverse fibres have now disappeared, and the longitudinal pyramidal fibres are grouped together in two compact masses, the crura cerebri, – the crura cerebri proper, *i.e.*, the crura cerebri of the dissector. Separated from these by the locus niger and the fillet, which is widening out preparatory



FIGS. 597 AND 598.—SECTIONS OF MESOCEPHALON (MESENCEPHALON). (Natural size.)

A: Section through inferior corpora quadrigemina. B: Section through superior corpora quadrigemina. *cr.*, crusta; *s.n.*, substantia nigra; *t.*, tegmentum; *s*, aqueduct of Sylvius with the surrounding grey matter; *c.q.*, grey matter of corpora quadrigemina; *l.g.*, lateral groove; *p.l.*, posterior longitudinal bundle; *d.V.*, descending root of fifth nerve; *s.c.p.*, superior cerebellar peduncle; *f.*, fillet *N. III.*, nucleus of third nerve: its roots are seen traversing the red or tegmental nucleus, and emerging at *III.*

to its division into three bands above mentioned, – lying above them, and uniting them superiorly, – is the prolongation of the formatio reticularis, here forming the greater part of what is called the upper part or tegmentum of the crura cerebri, – which upper part has little to do, however, with the crura cerebri of the dissector. Forming part of the transverse fibres of the formation about this region are, mesially, the decussation of the superior peduncles of the cerebellum, and, laterally, the lower or lateral fillet, reaching up to the tubercula quadrigemina. The aqueduct of Sylvius, which is more or less cross-shaped inferiorly, tends to become cylindrical. It is surrounded by the central grey matter of the iter, in the ventral part of which there is seen on either side the group of cells from which the 3rd nerve arises. The roots of this nerve are seen to pass downwards towards the inner surface of the crus, first traversing the red or tegmental nucleus. Externally to the nucleus of the 3rd nerve is the descending root of the 5th nerve (*d. V.*), with its nucleus. The posterior longitudinal bundle occupies the same position as in the previous section.

Substantia Nigra. – This is a band of darkly pigmented grey matter, crescentic on section, pierced internally by the roots of the 3rd nerve, and which extends from the pons Varolii to the tubercula quadrigemina, separating the crusta of the cerebral peduncles from the tegmentum. Its edges reach the surface at the lateral and oculomotor sulci. From its under surface numerous prolongations of the grey matter pass into the crusta.

The crusta is divided into a larger middle, and smaller inner and outer portions The fibres of the middle portion are the continuation of the pyramidal fibres of the medulla and pons; they are prolonged into the anterior half of the posterior limb of the inner capsule just behind the genu. and radiate towards the convolutions of the motor area. The fibres of the inner part of the crura pass through the anterior limb of the internal capsule, and radiate towards the convolutions of the frontal lobe. The fibres of the outer part of the crura traverse the posterior part of the inner capsule, and radiate towards the convolutions of the occipital and temporal lobes.

The superior peduncles of the cerebellum descend from the lower part of the optic thalamus into the tegmentum of the crus cerebri, and, having decussated in the formatio reticularis, emerge from beneath the testes as two rounded bundles joined together by the valve of Vieussens. They descend to the dentate nucleus and the lower part of the cerebellum.

The corpora quadrigemina are made up of grey matter with a superficial covering of white fibres. The brachia of the nates join the external geniculate body, and are continued into the outer part of the optic tract. The brachia of the testes are connected with the internal geniculate body, and probably join the inner part of the optic tract, but without becoming connected with the optic nerve; they go to form the commissural fibres of Gudden.

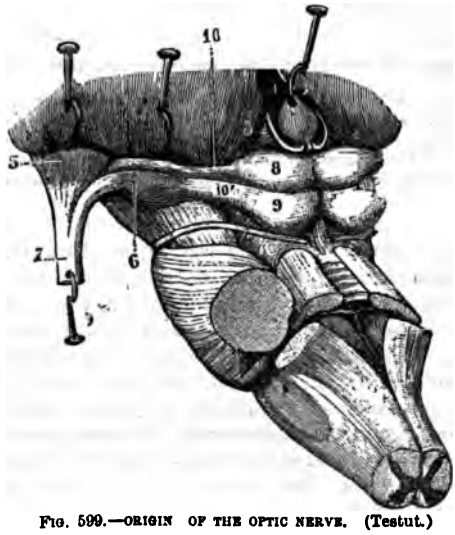


FIG. 599.—ORIGIN OF THE OPTIC NERVE. (Testut.)

8 and 9, anterior and posterior quadrigeminal bodies with 10 and 10', their respective branchia 5 and 6, external and internal geniculate bodies; 7, optic tract. The other indications are deleted; the figure will be found fully explained, p. 348vv. *See* p. 228d.

DEVELOPMENT OF THE BRAIN.

There are first the three original cerebral vesicles, – the fore-brain, the mid-brain, and the hind-brain, – and then, through the further division of the first and third of these, the five vesicles below named.

The hind-brain, which is elongated and tapering and continued into the spinal cord, is soon pinched off into the vesicle of the medulla, or *metencephalon*, posteriorly, and the vesicle of the cerebellum, or *epencephalon*, anteriorly. It is between these that the pontal flexure appears later on.

The mid-brain, or *mesencephalon*, increases in size less rapidly than the two others, and does not divide. While at first the largest of the three cerebral vesicles, it soon becomes the smallest of all.

The fore-brain divides as does the hind-brain. It first widens out posteriorly through the lateral projection of the two optic vesicles, and is then pinched off into the *thalamencephalon* with the now constricted stalks of the optic nerves, posteriorly, and the *prosencephalon*, or vesicle of the hemispheres, anteriorly.

There are now five vesicles: from behind forwards, the *metencephalon* and the *epencephalon* making up the hind-brain; the undivided mid-brain vesicle, or *mesencephalon;* and the *thalamencephalon* and the *prosencephalon* making up the fore-brain.

The vesicle of the hemispheres, or prosencephalon, is distinguished by extremely rapid growth, mainly in the backward direction; and it soon surpasses all the others in size, when it becomes parted from above into right and left halves by the future falx cerebri, a connective tissue formation derived from the membranous cranium.

The three cerebral flexures now appear, two curved forwards, with an intermediate one curved backwards.

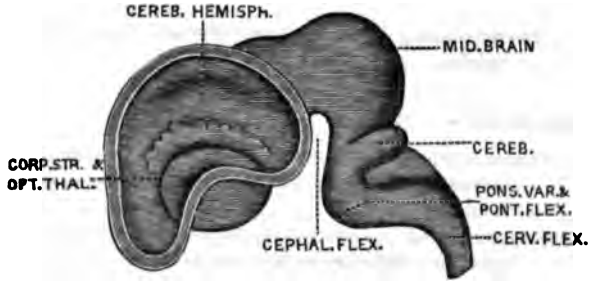


FIG. 600.—DIAGRAM SHOWING THE CEREBRAL FLEXURES. (After Hertwig.)

The fore-brain as a whole sinks downwards round the anterior extremity of the chorda dorsalis,* forming an acute angle with the mid-brain; this bend is the *cephalic*

* The chorda dorsalis extends forwards underneath the primitive tube of nervous substance as far as the interval between the fore-brain and the mid-brain.

flexure. There appears the sharp backward *pontal* flexure in the middle of the hind-brain, – that is, between the epencephalon and the metencephalon, or in the situation of the future pons varolii. Finally, there is a gradual bending forwards of the hind-brain as a whole on the future spinal cord: this is the *cervical* or *nuchal* flexure.

From the cerebral vesicles above named there are developed respectively: –

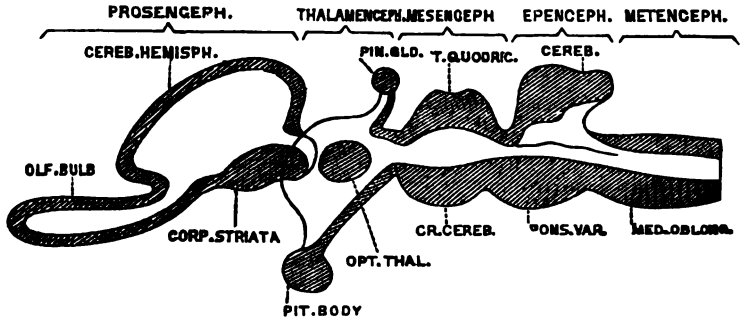


FIG. 601.—DIAGRAM SHOWING THE FIVE CEREBRAL VESICLES AND THE STRUCTURES DERIVED FROM THEM. (After Huxley.)

HIND-BRAIN. –

Metencephalon – Medulla oblongata, fourth ventricle.

Epencephalon – Cerebellum, pons varolii, crura cerebelli, valve of Vieussens.

MID-BRAIN. –

Mesencephalon – Tubercula quadrigemina, crura cerebri, aqueduct of Sylvius.

FORE-BRAIN. –

Thalamencephalon – Optic thalami; third ventricle; pineal gland, infundibulum & pituitary body; optic tracts, chiasma, optic nerves & retina.

Prosencephalon – Cerebral hemispheres; corpora striata; lateral ventricles; olfactory bulbs; corpus callosum, fornix.

Details may now be added: –

Metencephalon. – Its floor and sides thicken considerably, and become divided into the well-known columns of the medulla. Its roof produces no nerve-substance, and merely forms an epithelial investment to the plications of the thickened pia mater, or choroid plexuses of the fourth ventricle. Avulsion of the pia mater necessarily involves

the removal of the epithelial layer, and thus opens up the cavity of the fourth ventricle, – the rhomboidal sinus of the older authors being thus produced.*

Epencephalon. – The cerebellum first appears as a mere transverse ridge, of which the middle part is soon distinguished as the *vermiform process.* The lateral parts then outgrow the foregoing, and become the hemispheres. The transverse furrows appear shortly afterwards.

Mid-Brain.—This is the part that changes least. But, whereas, through the flexures above referred to, it occupies at an early date the highest part of the encephalon, and forms the prominent parietal eminence, it is afterwards covered over by the rapidly expanding cerebrum and cerebellum, and thus becomes crowded down to the base of the brain.

Thalamencephalon. – Its roof evolves very much like that of the metencephalon. It also remains epithelial, and similarly unites with the super-jacent pia mater to form the central part of the choroid plexuses or velum interpositum,† the avulsion of which, as it similarly involves the removal of the epithelial layer adherent to it, opens up the cavity of the subjacent third ventricle. Apart from the optic thalami and the optic vesicles further referred to in connection with the development of the eye, there grow out from the walls of the thalamencephalon two appendages of problematical significance, the pineal gland and the pituitary body.

The *Pineal Gland*, or *Epiphysis*, is evolved from the back part of the roof of the thalamencephalon as an evagination, which passes upwards and backwards. In man and mammals it becomes a solid outgrowth, glandular in appearance, and relatively unimportant. Without attempting to follow the very varying evolutions of the pineal gland in the vertebrate series, it may be mentioned that it acquires considerable importance in the lower vertebrates, such as selachians, where, perforating the cranium, it reaches the dermal surface. Its structure, in some reptiles, seems even to warrant its description as an unpaired parietal eye. Here appearances seem to indicate an optic nerve expanding into a kind of retina, with, in front of it, a lense-like arrangement covered in by translucent dermal scales. The apparatus seems, further, to be influenced by light.

The *Pituitary Body*, or *Hypophysis*, has a double origin. On the one hand, the floor of the thalamencephalon thins out and evaginates downwards, in the situation of the

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* It is taught by some scientists that the fourth ventricle is formed, not entirely by the metencephalon, but in its lower part by the metencephalon, and its upper part by the epencephalon. In such case what is above said of the roof of the metencephalon would apply also to the back part of the roof of the epencephalon.

† The velum interpositum, with the continuous choroid plexuses of the lateral ventricles and their descending cornua, are said, in human adult anatomy, to enter the brain through the great transverse fissure. Centrally this is not quite correct. The central part of the transverse fissure is no fissure at all in the proper sense of the term. There is no proper infolding here of the brain substance. It is the extension backwards of the hemispheres that causes the inclusion of the central part of the choroid plexus within the cerebral hemispheres, and gives rise to the appearance of a transverse fissure. Not so, however, at the side of the brain. Here, as will be seen further on, there is actual infolding, both of the brain itself, and of its piamatral covering.

future sella turcica, into a short funnel-shaped downgrowth, the infundibulum. Then in front of the infundibulum there appears the pouch of the hypophysis, or Rathke's pouch. This is an evagination of the oral sinus, in front of the pharyngeal membrane, which makes its way upwards in front of the foregoing, perforating the future ali-sphenoid. As it deepens, it becomes constricted off as a small sac, which is for a time connected by a narrow duct with the oral cavity, – the communication disappearing later on in man, though it remains throughout life in some of the lower vertebrates, such as selachians. The evaginations above described become, the one, the posterior or smaller, and the other, the anterior or larger, lobe of the pituitary body.

Prosencephalon. – Its extremely rapid growth backwards has already been referred to. This part of the brain overlaps the optic thalami in the third month, the tubercula quadrigemina in the fifth month, and, in man, the cerebellum a little later on. This growth of the hemispheres is marked by a twisting of the hemispheres upon themselves, – whence the twist of the anterior crura of the fornix and peduncles of Vick d'Azyr, – by the infolding of their walls into *deep fissures* with, and into more superficial sulci without corresponding internal projections, and by the development of a system of commissures, such as the corpus callosum and fornix.

The first fissure to appear is the fissure of Sylvius. Starting from about the middle of the lower margin of each hemisphere, it passes upwards and backwards, indenting the cavity of the corresponding lateral ventricle; – the sides of the indentation subsequently thickening to form the corpus striatum.

The next fissures to appear are the hippocampal, and the fissura pallii or choroidea. The former gives rise in its posterior part to the hippocampus major. The latter gives rise to the so-called great transverse fissure, or fissure of Bichat. What happens is this: – The two hemispheres, or "mantle" part of the brain, as they are sometimes termed, grow backwards, – everywhere invested with pia mater, – and overlap the upper part and sides of the "stalk," or future ganglionic portion, – this being also invested with pia mater. It is the edges of the resulting cup-like depression that become the lips of the so-called transverse fissure; the layers of pia mater, brought into contact, fuse, and form the choroid plexuses and velum interpositum. (See note on previous page.) Changes subsequently occur here similar to those that have been described in the roof both of the metencephalon and of the thalamencephalon. The roof of the neural tube is attenuated into a single layer of epithelial cells closely united to the pia mater, which latter, as it makes its way into the ventricular cavities in the shape of vascular tufts, remains covered by the epithelium. Removal of the tufts necessarily tears away the epithelium as well; and then, but then only, is the ventricular cavity really open.

The calcarine fissure appears later on on the inner aspect of the evagination of the lateral ventricle which forms the occipital lobe; it gives rise to the calcar avis.

Finally, there appears the external parieto-occipital fissure, which marks the separation between the parietal and occipital lobes.

The corpus callosum, the columns of the fornix, and the septum lucidum result from adhesions between the contiguous inner walls of the hemispheres. The septum lucidum is the attenuated remains of a portion of such contiguous walls, – the so-called fifth ventricle resulting from the enclosure of a part of space between the two hemispheres.

The correlated changes in the shape of the lateral ventricles necessarily bring about a narrowing of the communication, – foramen of Monro, – between these and the third ventricle.

There now appear such superficial infoldings as do not cause projections into the ventricular cavities, – these infoldings causing both relatively deep primary, and relatively shallow secondary and tertiary sulci. The first sulcus to appear, and the most important of the primary sulci, is that known under the name of fissure of Rolando.

Finally, there appears the evagination of the anterior part of each lateral ventricle, which forms the olfactory lobes. In man, these diminish somewhat in size in the later stages of evolution, and become filled up with nervous substance. In most mammals, however, whose sense of smell is keener than that of man, the olfactory lobes attain a considerable size, and remain hollow, their cavity not unfrequently remaining continuous with that of the ventricle.

EXPLANATION OF FIGURES NOT FULLY EXPLAINED IN THE TEXT.

(NERVE CENTRES.)

FIG. 501.—UNDER SURFACE OF THE CEREBRUM. (Sappey, Hirschfeld.)

1, 2, 3, frontal, temporal, and occipital poles; 4, 5, anterior and posterior extremities of the longitudinal fissure; 6, 7, stem of the fissure of Sylvius, and anterior perforated space; 8, 9, 10, tuber cinereum, with the infundibulum corpora albicantia, and locus perforatus posticus; 11, crus cerebri; 12, pons Varolii; 13, 14, 15, medulla oblongata, anterior pyramid, and olivary body.

The Cranial nerves are marked I. to XII. according to Sömmering's classification:

I. – Olfactory;
II. – Optic;
III. – Third, or Motor oculi;
IV. – Fourth, or Pathetic;
V. – Fifth, or Trigeminal;
VI. – Sixth, or Abducens;
VII. – Seventh, or Facial;
VIII. – Eighth, or Auditory;
IX. – Ninth, or Glosso-pharyngeal;
X. – Tenth, or Pneumogastric;
XI. – Eleventh, or Spinal accessory;
XII. – Twelfth, or Hypoglossal.

FIGS. 504 & 508.—MESIAL SECTION OF THE HEMISPHERES. (Hirschfeld.)

1, 2, 3, frontal, temporal, and occipital poles; 4, 7, 8, corpus callosum, with its posterior extremity or splenium, and its anterior extremity or genu, the latter continued into the beak or rostrum; 5, 6, convolution and ventricle of the corpus callosum; 10, fornix; 11, septum lucidum; 12, 13, upper and inner surfaces of optic thalamus, – a portion of the latter being shaved off to show the bundle of Vicq d'Azyr passing up from the twisting upon itself of the anterior crus of the fornix in the corpus albicans, 15; 16 foramen of Monro; 17, divided anterior commissure; 18, 19, posterior crus of fornix and corpus fimbriatum 20, 21, dentate convolution and fissure; 23, 24, olfactory process and bulb.

FIGS. 511 & 528.—DEEP DISSECTION OF THE BRAIN FROM UNDERNEATH. (Hirschfeld.)

1, 2, corpora geniculata and commencement of optic tract; 3, 4, divided crus cerebri and optic thalami; 5, 6, corpus albicans and tuber cinereum; 7, splenium of corpus callosum, showing its transverse fibres; 8, 9, longitudinal and oblique fibres of under surface and borders of fornix, going to form its anterior and posterior crura; 10, the lyra; 11, 12, anterior crus of fornix and corpus albicans; 13, transverse commissure cut short where it is bending backwards into the lenticular nucleus and optic thalamus; 14, 15, 16, posterior crus of fornix, corpus fimbriatum, and uncus of gyrus uncinatus; 17, dentate convolution; 18, 19, descending and posterior cornua of the lateral ventricle seen from below, the latter showing the hippocampus minor or calcar avis; 20, under surface of corpus callosum, showing the forceps major and minor, and the tapetum; 21, 22, beak and rostrum of the corpus callosum; 23, lenticular nucleus, externally to which are seen the claustrum, and the insular and opercular convolutions.

FIGS. 51 , 525, 544.—MESIAL SECTION OF ENTIRE BRAIN. (Sappey, Hirschfeld.)

1, 2, frontal and temporal poles; 3, convolution of corpus callosum; 4, 6, quadrate and cuneate lobules, separated by the internal parieto-occipital fissure, 7; 5, marginal convolution; 8, calloso-marginal fissure; 9, 10, 11, 12, corpus callosum, with it genu, beak, and splenium; 13, 14, fornix; 15, its anterior crus passing down in front of the foramen of Monro, 16, and behind the anterior commissure, 24, to the corpus albicans, 17, in which it twists upon itself to reascend to the optic thalamus, forming the bundle of Vicq d'Azyr; 18, septum lucidum; 19, choroid plexus; 20, 21, pineal gland and its superior peduncle or stria pinealis; 22, middle or grey commissure on inner surface of optic thalamus; 23, tubercula quadrigemina; 25, 26, aqueduct of Sylvius and valve of Vieussens or superior medullary velum; 27, fourth ventricle; 28, 29, inferior vermis and arbor vitæ of cerebellum; 30, 31, tuber cinereum, infundibulum, and pituitary body; 32, optic nerve; 33, 34, section of pons and medulla.

FIG. 552.—OPTIC THALAMUS AND MESOCEPHALON SEEN FROM BEHIND. (Testut.)

1, third ventricle; 2, pineal gland hooked up, with the striæ pineales on either side; 3, trigonum habenulæ; 4, pulvinar of optic thalamus; 5, 6, 7, corpora geniculata externum & internum, and optic tract; 8, 9, 10, 10', nates and testes, with the anterior and posterior brachia; 11, crus cerebri; 12, pons Varolii; 13, 14, 15, 16, valve of Vieussens, with the superior peduncle of the cerebellum, the origin of the fourth nerve, and the fillet; 17, fourth ventricle; 18, 19, middle and inferior peduncles of the cerebellum.

FIG. 553.—THE DURA MATER AND NERVES PIERCING IT, AND THE SINUSES. (Sappey.)

1, falx cerebri with the superior and inferior longitudinal and straight sinuses; 2, 4, 6, 7, 8, right half of the tentorium cerebelli seen from underneath; 9, 10, 11, 12, lateral and sigmoid, superior and inferior petrosal, and occipital sinuses; 13, falx cerebelli; 14, optic nerve; 15, 16, 17, 18, 3rd, 4th, 5th, and 6th nerves; 19, 7th and 8th nerves; 20, 9th, 10th, 11th nerves; 21, 12th nerve; 22, 23, the 1st and 2nd cervical nerves; 14, upper extremity of the ligamentum denticulatum; 25, the vena Galeni.

FIG. 555.—THE SUPERIOR OCCIPITAL FORAMEN. (Hirschfeld, Macalister.)

1, optic nerve; 3, 4, 5, 6, third, fourth, fifth, and sixth nerves; 7, 8, 9, the three divisions of the fifth nerve; 10, opening for infundibulum; 11, free border of tentorium cerebelli.

FIG. 564.—THE SPINAL CORD AND ITS RELATIONS AS SEEN FROM IN FRONT. (Hirschfeld.)

A, superior longitudinal sinus; B, C, D, ramifications of the anterior, middle, and posterior cerebral arteries; E, F, vertebral, and basilar arteries; G, the vertebral artery in the series of foramina in the transverse processes; H, anterior spinal artery; I, internal carotid artery.

1, 2, 3, 4, frontal and temporal lobes, pons Varolii, and medulla oblongata; 5, olfactory nerve; 6, optic chiasma; 7, third nerve; 8, fifth nerve; 9, sixth nerve; 10, facial and auditory nerves; 11, glosso-pharyngeal, pneumogastric, and spinal accessory nerves; 12, hypoglossal nerve; 13 to 13, the conjoined anterior spinal arteries; 14 to 14, ligamentum denticulatum; 15, ligamentum centrale; 16, 16, anterior roots of the spinal nerves; 17, 17, anterior divisions of the spinal nerves; 18, 18, ganglia on the posterior roots; 19, 20, 21, 22, cervical, brachial, lumbar and sacral plexuses; 23, 23, 24, cervical portion of the sympathetic, showing the three cervical ganglia and cord of communication, ascending branches running on the internal carotid artery, and communications with the cervical plexus; 25, 25, 26, 26, thoracic portion of the sympathetic and communications with the intercostal nerves; 27, 27, 28, 28, lumbar and sacral portions, and communications; 29, 30, greater and lesser splanchnic nerves; 31, coccygeal ganglion, or ganglion impar.

FIG. 565.—THE SPINAL CORD AND ITS RELATIONS AS SEEN FROM BEHIND. (Hirschfeld.)

A, B, C, vertebral artery, with its posterior inferior cerebellar, and posterior spinal branches.

1, 2, 3, 4, sections of optic thalamus and of the peduncles of the cerebellum, tubercula quadrigemina, and floor of the fourth ventricle; 5, fourth nerve; 6, linea transversæ and auditory nerve; 7, glosso-pharyngeal, pneumogastric, and spinal accessory nerves; 8, hypoglossal nerve; 9, 9, the continuation of the posterior spinal arteries along the whole length of the cord; 10, 10, ligamentum denticulatum; 11, ligamentum centrale; 12, 12, 13, 13, the posterior roots of the spinal nerves and their ganglia; 14, 14, 15, 15, posterior and anterior divisions of the spinal nerves.

PRACTICAL QUESTIONS ON PART III.

HEAD & NECK.

73. Feel the pulsations of the frontal, supraorbital, temporal, posterior auricular, and occipital arteries, and trace their course.

74. Trace the course of the supraorbital, supra-trochlear, auriculo-temporal, posterior auricular, and great & small occipital nerves.

75. Trace the lines of the superior longitudinal and lateral sinuses, and mark the lowest levels of the anterior, middle, and posterior lobes of the brain.

76. Find the bregma, trace the line of the fissure of Rolando, and indicate roughly the position of the cortical centres for the muscles of the upper and lower limbs, and the face.

77. Show where the anterior branch of the middle meningeal artery crosses the anterior inferior angle of the parietal. Point out the thickest and thinnest parts of the skull.

78. Look into the external auditory canal, and examine the membrana tympani.

79. Put your finger upon the infraorbital & mental foramina.

80. Draw the lines of the facial artery and its principal branches, and show where its, and their, pulsations can be felt. To what depth do you drive the pins in the suture for hare-lip, and why? Draw the line of the facial vein.

81. Show the course of the lachrymal canals, and indicate the position of the lachrymal sac. How would you open the latter? Show the tendo oculi. Feel the pulley of the superior oblique.

82. Draw the lines of Steno's duct, and of the facial nerve & its principal branches. How would you open an abscess over the ramus of the jaw? Find the aperture of Steno's duct in the mouth.

83. Show where, and how, you would tap the antrum.

84. Show the ranine veins, and indicate the position of the ranine arteries, and that of the sublingual artery on the floor of the mouth.

85. Examine the throat, and explore the posterior nares. Show externally the position of the tonsil. Where would you divide the gustatory nerve?

86. Trace the course of the external jugular vein.

87. Feel the hyoid bone, the thyroid & cricoid cartilages, and the crico-thyroid interval. Show the position of the lobes and isthmus of the

thyroid gland. Mark out the incisions for laryngotomy, and for tracheotomy above and below the isthmus.

88. Draw the line of the common carotid artery, and compress the artery upon Chassaignac's tubercle. At what level is the artery crossed by the omohyoid? Where, and how, would you tie it?

89. Demarcate the triangle formed by the two bellies of the digastric & stylo-hyoid. Show the position of the several structures it contains. How would you cut down upon the lingual artery?

90. Feel the pulsation of the subclavian artery, and compress the artery on the first rib. Where, and how, would you tie the artery? Indicate the position, with reference to the artery, of the vein, the cords of the brachial plexus, and the omo-hyoid muscle.

91. Mark the course of the chief superficial nerves of the neck, and that of the spinal accessory nerve.

THORAX.

92. Map out on the front of the chest the position of the heart and great arterial & venous trunks. Show how high the left innominate vein may rise in the child's neck.

93. Map out the lungs. Show how high the apex of the lung rises in the neck.

94. Show the point of division of the trachea.

95. Draw the line of the internal mammary artery.

96. Map out the pectoral muscles, and show the direction of their fibres.

97. Count the ribs & intercostal spaces, and show where you would tap the chest. Which rib can you immediately identify? (The second, since it lies opposite the transverse ridge which marks the junction of the manubrium with the body of the sternum.) If called upon to do so, where would you tap the pericardium?

98. Count the spines of the vertebræ, and indicate the correspondences of the principal spines. How would you easily identify the spines of the third, eleventh, and twelfth dorsal, and fourth lumbar vertebræ?

99. Point out the vertebra prominens, and feel the bifid spine of the second cervical vertebra. Feel the transverse process of the atlas.

100. Mark out the scapula with its spine, and the acromion process.

APPENDIX.

BASILAR ARTERY

Formed by junction of the two vertebral arteries opposite lower border of pons Varolii, and ex
to upper border of the s

BRANCHES:

COLLATERAL:

Transverse Arteries of the Pons – Directly outwards over pons. One ac
panies auditory nerve into internal auditory meatus, and become
auditory a

Anterior Inferior Cerebellar – Along crus cerebelli to anterior part of u
surface of cerebe

Superior Cerebellar – Winds round crus cerebri with 4th nerve to upper su
of cerebellum and gives twigs to velum interpos

TERMINAL:

Posterior Cerebral – Two. Vide arteries of base of brain.

INFERIOR THYROID ARTERY.

(*Vide page* 159

Tortuous course upwards & inwards behind common carotid a
& sympathetic nerve, (the middle cervical ganglion, when present, resting
it) to under surface of thyroid gland, and anastomoses with the other th
arteries. – Gives off brau

ASCENDING CERVICAL – Ascends between scalenus anticus & rectus capitis an
major; gives branches to deep muscles of neck, and, through the i
vertebral foramina, to spinal cord & its membranes and bodies o
vert

LARYNGEAL – Upon trachea to back of larynx; supplies muscles & mucous
b

TRACHEAL – Join below with bronchial.

ŒSOPHAGEAL – Descend upon œsophagus.

THE CLASSIFICATION OF JOINTS.

The joints may be divided into:

SYNARTHROSES — The bones are immoveably interlocked, and are in almost immediate contact, being separated only by a thin layer of periosteum termed the sutural ligament, and, at the base of the skull, by a thin layer of cartilage. – The varieties are the:

Sutura Vera – The bones present a series of processes & indentations, which fit in with each other. The subvarieties are the:

S. DENTATA – The interlocking processes are large & ramified. – Ex.: *Sagittal & lamboid sutures.*

S. SERRATA – The interlocking processes are smaller & more regular. – Ex.: *Temporary suture in middle line of frontal bone.*

S. LIMBOSA – The articular surfaces are more or less bevelled, and one overlaps the other. – Ex.: *Fronto-parietal suture.*

Sutura Notha or False Suture – A mere apposition of rough surfaces. – The subvarieties are the:

S. SQUAMOSA – Considerable overlapping of extensively bevelled surfaces. – Ex.: *Temporo-parietal suture.*

S. HARMONICA – Apposition in the mesial line of two symmetrical & vertically cut surfaces. – Ex.: *Articulation between the two halves of the upper jaw.*

Schindylesis – A thin plate of bone is received into a cleft formed by the separation of the two plates of another bone. – Ex.: *Articulation of the rostrum of the sphenoid with the vomer.*

Gomphosis – The implantation of the teeth into the alveolar processes.

AMPHIARTHROSES — The bones are bound together *almost* immoveably by means of thick plates of fibro-cartilage extremely adherent to each bone, and by strong external ligaments. In some cases the articular surfaces are partly covered by a thin layer of cartilage, and are partly lined with synovial membrane. The one class of amphiarthroses resemble the synarthroses, the other class resemble the diarthroses.

DIARTHROSES — The bones are bound together by means of external ligaments lined with synovial membrane, and the articular surfaces are covered with cartilage. Plates or rings of fibro-cartilage are sometimes included within the articular cavity, which cavity they occasionally divide into two distinct parts. – The arthrodiæ having recently been subdivided by Cruveilhier into arthrodiæ proper, condyloid articulations, & articulations by reciprocal reception, the varieties of the diarthroses may now be enumerated as follows (in the order of decreasing variety & decreasing extent of the movements they admit) – :

Enarthroses – Globular head received into a cup-shaped cavity. Well defined capsular ligament. The movements are flexion, extension, adduction, abduction, circumduction, & rotation. – Ex: *Hip-joint.*

Articulations by Reciprocal Reception – Articular surfaces inversely convex in one direction & concave in the other. Capsular ligament less perfect & complete than in the enarthroses. The movements are flexion, extension, adduction, abduction, & circumduction; there is no of axial rotation. – Ex: *Articulation of the metacarpal bone of the thumb with the trapezium.*

Condyloid Articulations – Ovoid articular head, or condyle, received into an elliptical cavity. Strong anterior, posterior & lateral ligaments. Flexion & extension very free; adduction, abduction & circumduction, rather less so; no axial rotation. Ex: *Wrist-joint.*

Ginglymi – Trochlear surface on the one hand, cavity of reception to correspond, on the other. Strong lateral ligaments; anterior & posterior ligaments but slightly marked. Flexion & extension only. Ex: *Elbow-joint.*

Diarthroses Rotatorii – Pivot-like process turning in an osteo-fibrous ring, or osteo-fibrous ring rotating upon an axial process. Rotatory movements only. Ex: *Superior & inferior radio-ulnar articulations.*

Arthrodiæ Proper – Articular surfaces flat or nearly so. Thin & loose capsules. Only gliding movements, which movements are never very extensive. Ex

Acromio-clavicular *articulation*

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